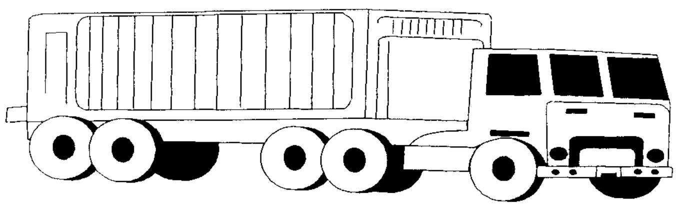
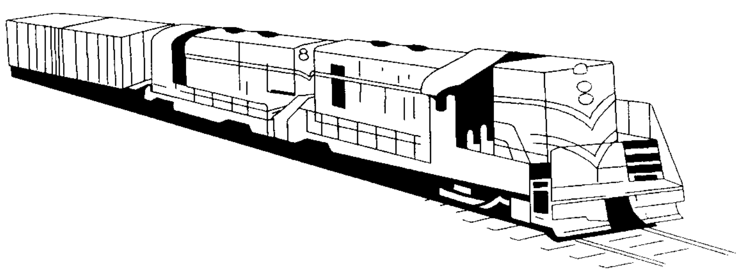
CONFERENCE TWO
PREFACE





1. URBAN GOODS AND FREIGHT FORECASTING CONFERENCE OPENING SESSION AND ACKNOWLEDGMENTS

Robert J. Czerniak
New Mexico State University
Las Cruces, New Mexico

OVERVIEW AND INTRODUCTION

The Urban Goods and Freight Forecasting Conference was sponsored by the Federal Highway Administration, Office of Environment and Planning, Statewide and Intermodal Planning Division. The FHWA contact for this project was Mr. Dane Ismart. We would like to thank him for his cooperation and thoughtful review of the program and conference arrangements.

The purpose of the Urban Goods and Freight Forecasting was to present the Federal Highway Administration with recommendations that can be used to help formulate freight planning and modeling research and programming efforts for the next three to seven years. The conference brought together a number of experts on freight planning and modeling, as well as, staff from a variety of Metropolitan Planning Organizations, State Departments of Transportation and the private sector who are concerned about freight issues.

The conference program and local arrangements were provided by New Mexico State University, Department of Geography. The conference was divided into two major parts. First, a series of presentations by experts in the field of modeling, policy analysis and freight data was presented. Second, conference participants separated into three discussion groups. They responded to a series of questions that were developed prior to the conference regarding the future activities of FHWA in terms of freight modeling research and freight data research. As is the case with most group discussions, each of the three groups eventually asked their own questions and developed unique discussion topics.

CONFERENCE PROCEEDINGS

The conference proceedings is a detailed review of the presentations and discussions that took place during the conference. The proceedings also includes two invited papers. Arun Chatterjee's paper provides a historical context for freight planning and modeling in the U.S. Tom Maze et al gives insight into the development and use of a statewide freight model.

ACKNOWLEDGMENTS

The following people deserve our appreciation in making the conference a positive experience: George Schoener-FHWA, Statewide and Intermodal Division, Gordon Shunk-Texas Transportation Institute, Janet Oakley-Association of Metropolitan Planning Organizations and June Houseman-Texas Transportation Institute. We would also like to thank David Albright, President of the Alliance for Transportation Research, Reebie Associates and Parsons, Brinckerhoff, Douglas and Quade Inc. for sponsoring the October 15 conference reception. Of course, we would also like to thank all the presenters, authors and participants.

2. KEYNOTE ADDRESS
URBAN GOODS MOVEMENT
AND ITS RELATION TO PLANNING

Professor K.W. Ogden
Institute of Transport Studies
Department of Civil Engineering
Monash University
Melbourne, Australia

INTRODUCTION

The topic I have been asked to address is that of urban goods movement forecasting and its relationship to planning. In order to approach that question in a useful way, it is first necessary to develop an understanding of the subject matter, namely urban goods movement, because without such an understanding we really don't know what we are doing or what outcomes we can usefully achieve from a forecasting or modelling exercise.

The paper therefore commences with a discussion of the nature and characteristics of urban goods movement. It then addresses the question of the relationship between urban goods movement and planning, focussing particularly upon planning-related questions which modelling and forecasting can help answer. It includes some observations about the planning applications of urban goods modelling and data, and concludes with some issues and challenges which this Conference could usefully address.

URBAN GOODS MOVEMENT

It is fundamental that we grasp the reality that freight transport is not an end in itself. Goods do not move for their own sake, but only if they are of greater value at some location other than their current one. The freight system therefore essentially exists to serve other productive sectors of the economy.

The urban freight sector is extremely complex and heterogenous, typically categorised by a large number of relatively small firms, each specialising in a particular market niche. Added to this are private trucking operations, i.e. trucks owned by companies to carry their own products, and trucks which are not really freight-carrying vehicles, such as service vehicles. Within a large metropolitan area, most freight activity is internal to that area, but there are significant external (import and export) movements, and possibly through movements as well. The result is an extremely complex entity, with little in common between the various component parts.

Moreover, increasingly, freight activities involving the movement of manufactured products are being seen as but one part, albeit an important part, of a broader process of logistics management, which may be defined as "having the right quantity of the right product in the right place at the right time" (Hutchinson, 1987). Importantly, shippers may deliberately incur a higher price in transportation (e.g. use of a reliable mode) in order to achieve savings elsewhere (e.g. reduction of inventory). For manufactured goods in western economies, the total logistics costs (including inventory control and purchasing management, warehousing costs, materials handling, packaging, insurance, logistics information systems, etc) may total around 20 per cent of the total costs of production. Transport typically accounts for around one-third of this. Clearly therefore, a logistics manager, even assuming a goal of minimisation of logistics costs, has ample scope and opportunity to trade off transport costs against savings elsewhere in the logistics chain.

Significant changes are taking place globally in the nature of wealth creation and the significance of logistics management within that. These include (Peters, 1991; Organisation for Economic Cooperation and Development, 1992):

- technological development and globalisation of business have reduced the capability of firms to use "brand power" and to differentiate products; availability of the product is all important in this context since customers will not and need not wait for the products of a specific supplier;
- global sourcing of components, perhaps most graphically revealed in the auto and computer industries; an efficient and reliable distribution system is an absolute pre-requisite to a firm's ability to be even considered as a global supplier of product;
- outsourcing of components, from a smaller number of suppliers on longer term contracts, with strong "strategic alliances" between customers, suppliers and the logistics company;
- shorter product life cycles, resulting in shorter procurement lead times and tighter distribution schedules;
- a shift in the distribution emphasis from supplies by producers at their convenience, to meeting customer needs, often in response to the disparate needs of the manufacturer's customers; "just in time" (JIT) delivery systems are increasingly the norm, placing an emphasis on reliability of transport systems;
- lower levels of inventory to preserve capital; the JIT system is relevant here also;
- as a result of the above factors, there is a greater emphasis of niche marketing within a greater product range, leading to the need for flexible, customised distribution systems;
- an emphasis on quality of finished product, including quality and reliability of product delivery;

- a move to "value-adding" at each stage of distribution chain; for example, a delivery operation in many cases today also includes such aspects as unpacking, assembly, testing, customising to the customers requirements, rudimentary training of the purchaser, etc;
- an increasing trend towards "electronic commerce", whereby the computers of each component in the chain (e.g. customer, importer, shipping company, road and rail freight operator, customs, supplier, banker, insurer, etc) "talk" to each other, perhaps without human intervention; this substitution of information and transport for inventory is becoming increasingly critical to the management of complex and inter-related businesses.

It is in this context therefore that our efforts to model and forecast urban freight activities must take place. If we are serious about improving our urban transport systems for freight transport (which presumably is the objective of planning and forecasting) we must make the effort to understand the nature of the demand we are analysing, and the factors affecting it. As the above list indicates, most of these influences are outside the transport system, but impact critically upon it.

The corollary of this argument from the viewpoint of transport planning and policy is that urban freight is an important and legitimate target of our activities and responsibilities. More formally:

- It is very significant in economic terms. The total resource costs of urban goods movement are comparable to those of urban person movement (Bureau of Transport Economics, 1978; Kearney, 1976). In other words, about half of total urban transport costs, in economic terms, are related to freight.
- As a consequence, it is important to the regional economy, and to the economic viability of the region and the nation. An efficient freight system within cities is a key to the ability to compete on domestic and international markets. In particular, the urban freight system is of critical importance to the trade-exposed manufacturing sector - those industries which export their products or compete with imports.
- Of particular concern is traffic congestion. A Los Angeles study (Southern California Association of Governments, 1988) estimated the daily recurrent congestion costs in the Los Angeles metropolitan area at $US7.1 million per day, with one-third of this incurred by business travellers. In Melbourne, Australia (Miles and Bui, 1992) the cost of traffic congestion has been estimated at about $US1.3 billion per year, with two-thirds of incurred by commercial vehicles, mainly trucks. An important point to note here is that traffic congestion forms part of the operating environment for a freight operator, so costs of delay are passed on to customers. The problem of the cost of congestion is therefore one for the community as a whole, not for the freight industry. Traffic congestion also has occupational health and safety implications.
- Freight movement has adverse impacts. The community is understandably concerned about such things as noise, emissions, road crashes involving trucks, hazardous goods storage and distribution, etc.

In summary, one cannot escape the conclusion that the rapidly-changing demands being placed on the freight sector mean that a policy of "benign neglect" is no longer a responsible one for urban transport policy makers and planners. With the higher value of goods which modern industry is producing, customers are increasingly demanding a freight service which can deliver with high punctuality and reliability, offers high frequency, has the capacity to accommodate the demand, the flexibility to respond to short term demands, and which minimises damage to the product (Nicolin, 1989).

URBAN FREIGHT ACTIVITY PATTERNS

At this point, it is useful to outline what we know about the dimensions of urban freight as a part of the urban transport system. However, this must be a very limited discussion, because the reality is that, while we know some things, there is much that we know little about, such as the patterns of origin and destination of goods movements, or the daily patterns of truck movements. We know little (except by inference) about the value of the goods being moved. Very few cities anywhere in the world have good, recent data on metropolitan-wide freight and trucking activities, and their role within the total urban transport system. Exceptions are Chicago, IL (Reilly, Rosenbluh and Rawling, 1987) and Sydney, Australia (Taylor, Maldonado and Ogden, 1994).

We do know that:

- With few exceptions, freight within our cities is almost entirely carried on roads. (Pipelines are very important, but as they are commodity and origin-destination specific, are not usually considered as part of the urban freight system.) For surface transport, the diverse patterns of origins and destinations, the short distances involved, and the time sensitive nature of many of the movements mean that the technology most suited to almost all urban freight is a road vehicle - trucks and vans. Other modes, such as rail or barge transport, may have a role in niche markets in some cities such as New York, and should not be overlooked (Strauss-Wieder, Kang and Yokel, 1989; New York City, 1990).
- The commodities carried are mostly bulk products and manufactured goods. Typically, the major tonneages are accounted for by unprocessed building materials (e.g. sand, gravel), metal manufactured products, food products, concrete products, petroleum products and waste (Ogden, 1992). In terms of the products carried on truck trips, the major products include parcels and express freight, machinery, printed matter, mail, and service equipment (Rawling, 1989).
- On the road system, trucks typically account for a small percentage of vehicle kilometres (vehicle miles) of total urban travel - perhaps 4-5 per cent. Tractor semi-trailers and other combination vehicles usually carry the bulk of the tonneage.

URBAN FREIGHT POLICY OBJECTIVES

To develop coherent and useful policies for urban freight planning, it is necessary to be clear about the goals of such policy. As an overall goal, it is postulated that urban areas should attempt to minimise the *total social cost* of moving goods, commensurate of course with meeting the freight needs of the community (Ogden, 1992).

Within that overall goal, it is suggested that there are six sets of more specific policy objectives:

- **Public sector macro-economic performance**: to contribute towards local, regional, state and national economic performance.
- **Cost and quality of freight services:** to improve freight efficiency and productivity by reducing transport operation costs, especially those associated with traffic congestion.
- **Environmental:** to minimise the adverse environmental effects of freight activities (terminals and transportation), especially noise, emissions, vibration, and intrusion into residential areas.
- **Infrastructure and management:** to provide and manage an adequate public infrastructure, especially related to the provision and maintenance of the road system and terminals, and appropriate regulation of trucking operations.
- **Road safety:** to minimise the number and severity of truck crashes.
- **Urban structure:** to contribute towards "desired" urban structure, especially through the location of freight generators and terminals.

This is not the place to attempt to develop these objectives in any detail. However, it is important to note that, as with any area of policy development, the challenge is to determine an acceptable balance between these objectives, since in some cases they conflict or are mutually inconsistent.

PLANNING STRATEGIES

There are many strategies which are applicable to the pursuit of these urban freight policy objectives (Ogden, 1992). For completeness, a few of the more significant strategies which are pertinent to freight forecasting or modelling in a planning context will be briefly reviewed in the following discussion.

Infrastructure Planning

As noted above, it is increasingly being recognised that the economic development of a metropolitan area is related to the quality of its freight transport system. In Melbourne, Australia, for example, a very significant study carried out by the Road Construction Authority (1987) showed the key importance of urban road investment in encouraging development of the region's manufacturing industry. It concluded that reduced urban freight costs resulting from either travel time savings or more reliable delivery times directly affected the profitability and competitiveness of Melbourne manufacturers. On this basis, it showed that the economic benefits from urban road investment were much greater than had hitherto been calculated, when the flow-on benefits were included. It concluded that "estimates of the ultimate benefits to the national economy from major urban road improvements should involve increasing the benefits conventionally calculated for the freight sector (for time and cost savings) by about 50 per cent."

This was a very important conclusion, and one which has since been corroborated by other studies. For example, a British study (Quarmby, 1989) concluded that the benefits to commercial vehicles of road improvements could exceed the benefits of straight time savings by 30-50 per cent. Lewis (1991) has also shown that the economic benefits of urban road investment through export enhancement and reduced freight costs are very significant. Hussain (1990) has shown that cities with strong road networks, particularly those which facilitate industrial activity, will attract investment and economic growth. Cox (1992) has also shown a strong link between transport infrastructure investment and economic development, in particular drawing attention to the positive influence of road investment in urban fringe areas.

The Southern California Association of Governments (1983, 1989) in a study of the relationship between international trade and the transport system suggested that the following types of infrastructure were of key importance in this context:

- improved access to ports and airports,
- enhanced access and circulation at ports and inland markets and intermodal transfer points,
- eliminate where possible unnecessary delays and circuitous routing of goods on the region's transport system,
- plan and provide for freight routes which minimise impacts on residential neighbourhoods and heavy commuter routes,
- support freight consolidation and improvement of intermodal facilities, and construction of on-dock and near-dock container transfer facilities, and
- provide for efficient freight movements at locations where passenger movement dominates, especially at airports.

These findings imply that the benefits to a region's economy which result from certain freight-related road improvements are much higher than hitherto considered. A higher level of road investment, or a redirection of investment from person-oriented travel to freight travel is thus likely to be economically justified.

Importantly, these results arise from analyses using General Equilibrium models of national and regional economies, which accommodate the effect of efficient transport on stimulating other sectors of the economy (Aschauer, 1989; Willeke, 1992). By contrast, urban transport planners and modellers are more used to working with partial equilibrium models which implicitly assume that the effect of infrastructure investment conveys benefits only to users, and ignores the downstream effects of those benefit streams (Lewis, 1991; Smith, 1994).

Vehicle Regulations

Most of the urban freight task is carried out by the private sector. The public sector role includes investment, as just mentioned, and regulation. One example of an area where regulatory reform could potentially contribute to the aforementioned objectives concerns restrictions on the use of high-productivity vehicles such as twin and triple-trailered trucks.

Regulations restricting the use of these high productivity vehicles vary considerably from place to place. However, the general point to be made here is that there could be potential benefits from the development of a limited network of roads upon which the use of high productivity vehicles is permitted. There are ample precedents for this on non-urban roads, for example the US federal-aid primary arterial network. In Melbourne, Australia recent proposals would allow the use on a limited network of roads near the seaport of "super B-doubles" with a gross vehicle mass of up to 108 tonnes, carrying two 40 ft or four 20 ft ISO maritime containers for a payload of up to 84 tonnes (DJA-Maunsell, 1995).

Terminals and Truck Loading Facilities

The provision of (and access to) truck terminals, inter-modal terminals and loading areas is often inadequate, leading to lengthy delays, double-parking of trucks, potential for theft, etc.

Building developers typically see these facilities as "dead space", and aim to provide as little as possible. The attention given to layout and access is often minimal. For these reasons, it is probably inevitable that some form of public intervention, in the form of building or planning regulations, is necessary to ensure that these facilities are provided (Walters, 1989). These should aim to ensure that there is sufficient number of loading spaces, that their design and layout permits efficient loading and unloading of goods, and that access to them is possible by the sorts of vehicle likely to service the building or site in question (Anderson, 1988).

With the increased emphasis being placed upon intermodal freight activities (i.e. containerised movements which utilise more than one freight mode) and the globalisation of manufacturing activities which is leading to multi-modal international freight movements, there will likely be increased emphasis in the years ahead upon efficient intermodal terminals and minimisation of the negative impacts of their operation (Muller, 1989).

Traffic Management Planning

There are many things which can be done by traffic engineers to take better account of the needs of heavy vehicles in the traffic stream. Delays experienced by trucks in traffic are very real. They affect truck operating costs, either directly through wear and tear and lower truck utilisation, or indirectly through truck operators having to program their work to avoid periods of peak congestion. Congestion also leads to hidden costs, such as stress-related health problems for truck drivers (Grenzeback, et al, 1990).

Conversely, trucks, being generally larger than passenger cars, effectively reduce the capacity of streets to handle passenger traffic. They also impede traffic flow because of slower acceleration away from traffic signals. Trucks may also impede the smooth flow of traffic when stopped for loading and unloading on the street (Habib and Crowley, 1976b).

Trucks may also be affected by road design and configuration to a greater extent than other vehicles. Typical problems include:

- narrow lanes;
- absence of pavement or lane markings;
- lane drops and trap lanes;
- poor maintenance of the road pavement;
- poor road geometry at intersections;
- sharp bends;
- excessive or incorrect road crossfall or superelevation;
- low clearances on overhead bridges
- poles, signs, etc close to the kerb line;
- overhanging trees;
- poor signing and street name signs.

Moreover, traffic signal operation often does not take full account of the needs of trucks. For example, a gap often opens up in front of a truck as it accelerates from rest at a traffic signal. Unless traffic signal controller time settings make allowance for this, the signal may turn red before the truck is able to enter the intersection. Similarly, although signals are usually linked in order to assist traffic flow, this can create particular problems for trucks if these are not carefully considered in design. Problems include the assumed speed profile of the traffic flow, which may lead to trucks falling behind the required rate of progression; and signals being set for the peak direction of flow whereas trucks may be predominantly travelling in a counter-peak or cross-town direction.

In addition, the geometric design of intersections should take account of the needs of the full range of vehicles likely to use them. This is often not the case, so far as large vehicles are concerned. As a consequence, turning trucks may be forced to encroach on opposing or adjacent lanes to create a sufficient turn radius. Often, the space available within the intersection precludes the provision of left turn and/or right turn lanes.

On the local street network, generally no special provision for large vehicles is necessary (and may in fact be undesirable as it may encourage unwanted use of local streets by large vehicles). However, it is important to realise that even local streets do have large vehicles with a genuine need to use them for access, rubbish collection, furniture removal, building construction, maintenance of service utilities, etc. Designers of local area traffic calming schemes in particularly should be mindful of these needs.

There is scope for good traffic engineering and design to attend to all of these issues (Ogden, 1991). Indeed, it could be argued that the greatest single area of payoff from a higher level of concern for urban freight activities is in the traffic management area; often all that is required is to take explicit account of the needs of heavy vehicles in traffic design and operation.

Land Use Planning

There are costs associated with a poor integration of land use and freight facilities. Moreover, once installed, new urban developments generally remain in place for many years; many of today's freight problems stem directly from poor location and land use decisions made in years past.

In a dynamic urban area, physical changes continually take place as the structure of the region responds to social, economic and technological change. Some of these changes which have a direct bearing on freight include the suburbanisation of residential, commercial and industrial activities; the development of regional shopping centres, the rapid rise in the economic importance of service industries, the relative use of road transport for line haul freight (with typically suburban terminals) and sea or rail (located near the historical centre); and the tendency towards development of integrated "parks" for industry, offices, etc.

Conversely, industrial location decisions affect freight flows. Land use planning policy in many cities has been to separate land uses. While there have been sound environmental reasons for doing so in many cases, the effect of this has been to build into our cities the need for massive and sustained freight flows. Planning which aims to integrate rather than separate complementary activities, where possible, may therefore have economic and environmental benefits (Chatterjee, Staley and Whaley, 1986).

Congestion Pricing

Congestion pricing, i.e. charging for the use of road space in reflection of the costs which are imposed on other road users, is gaining interest worldwide (Institute of Transportation Engineers, 1993). Asian cities have led the world in the development of real-time road pricing regimes, with Hong Kong and Singapore both having experimented with or developed such systems. It is possible that we will see many more cities, not only in Asia, considering this strategy in the near future, although there are significant social and political barriers (Giulano, 1993; May, 1993).

It can be shown that the usual form of paying for the provision and use of roads bears little relationship to costs (Small, Winston and Evans, 1989), with the result that there is excess demand. A pricing regime which reflects the congestion costs and possibly the environmental costs of road use offers a solution.

Real time road pricing is likely to be to the benefit of road freight movement in cities. One effect of real time road pricing is to price the marginal user off the road at periods of congestion, thus tending to reduce travel times and increase operating efficiency. The extent to which vehicles or users move to other modes, other times of day, or change their travel trip origins or destinations depends primarily upon the value they place on their travel time (Else, 1986).

Therefore, commercial vehicles as a whole stand to gain from road pricing (Ogden, 1992) because in many cases they will a higher value of travel time than private vehicles. For example, in a study in the United Kingdom, Button and Pearman (1981, p 167) concluded that "reduced congestion will almost certainly have favourable consequences for urban goods movement, i.e. it will speed up journeys, which permits greater utilisation of vehicles and crew and possibly results in indirect benefits from a smaller fleet requirement, and it also reduces the wear and tear on vehicles which accompanies frequent braking and acceleration. There is likely therefore to be some reduction in the generalised costs of haulage to offset at least part of the road price." They quantified this by quoting the results of a study undertaken in the 1970s in Coventry, UK. In this study, although trucks were to be charged at twice the rate for cars, all categories of truck (and also business cars) showed a significant reduction in costs, while private cars showed an increase.

FORECASTING AND MODELLING

It is axiomatic that if transport planners and policy makers are to take seriously any of the issues discussed in the previous section, some form of quantitative analysis involving forecasts of freight flows and their affects is necessary. Over the next few days, delegates to this Conference will attempt to advance the state of the art in freight modelling to enable these projections to be made with greater confidence. It is helpful therefore to be reminded of the objectives of the Travel Modelling Improvement Program (TMIP):

- to increase the ability of existing travel forecasting procedures to respond to emerging issues including: environmental concerns, growth management, and lifestyle along with traditional transportation issues,

- to redesign the travel forecasting process to reflect changes in behaviour, to respond to greater information needs placed on the forecasting process, and to take advantage of changes in data collection technology, and
- to integrate the forecasting techniques into the decision making process, providing better understanding of the effects of transportation improvements and allowing decision makers in state governments, local governments, transit operators, metropolitan planning organisations and environmental agencies the capability of making improved transportation decisions.

These objectives apply with equal cogency to the urban freight sector as to other transport sectors, and the previous discussion has highlighted how urban freight is relevant to these concerns.

It is interesting to consider the state of the art in the modelling and forecasting of person travel, to see what lessons can be learned for freight modelling. As the above discussion will have made clear, there are important and fundamental differences between the movement of goods and the movement of people which mean that models developed for the latter cannot be simply translated to the former. Nevertheless, there are some lessons to be learned.

In a report prepared as part of the TMIP process, Spear (1994) reviewed four submissions which had been commissioned by the Federal Highway Administration, concerned with a redesign of the travel demand forecasting process. Spear identified a number of common themes in three key areas: behaviourial assumptions, model methodology, and data requirements, as follows:

Behaviourial assumptions:

- *The demand for travel is derived from the demand to engage in various activities.* There is a clear analogy here in the freight field, in that the demand for freight is related to economic demand and supply considerations, i.e. to factors outside the transport sector.
- *Travel behaviour is stochastic rather than deterministic.* The analogy with freight is again obvious, and perhaps needs to be made with even greater force, given that the movement of goods is merely one part of a larger logistics process, and travel choices involve tradeoffs within that process.
- Travel behaviour is conditional upon longer term choices (e.g. of residential and employment location, vehicle ownership, and land use). This is partly true also of the freight field, in that there are some long term fixed parameters, particularly related to land use, such as the sites of ports, airports, quarries, major industrial sites, etc. However, there is also a plethora of other factors which probably change with greater rapidity in the freight field than their equivalents in person travel. Included here are such factors as the location of depots and terminals, which can be quite footloose (Young, Ritchie and Ogden, 1980), dynamic changes in choice of supplier and carrier, and the need to respond to demands for new products from new sources, including sources which are outside the urban area concerned.

- *Travellers exhibit adaptive behaviour in response to transport system changes.* This too applies within the freight field, though perhaps with shorter lag times than are customary in the person movement field.

Methodology:

- *Geographic information systems (GIS) should be used as the platform for data management, model integration, and display.* This has direct application in the urban freight field (Chapleau, 1995).
- *The route choice/assignment model should be enhanced to incorporate time-sensitive network loadings and departure time decisions.* Our understanding of the factors affecting truck driver route choice is limited. It is affected by such things as the more limited network which is physically, legally, or perceptually available to a truck driver, and is conditional upon such external factors as pick up and delivery route optimisation, urgency of delivery, and company policy.
- *Expand the use of disaggregate choice models.* The general point is valid to freight modelling, but again, we don't know enough about who makes the critical choices in the freight field, or the factors affecting such decisions. A fundamental point of distinction between freight and person modelling is that in the latter, we can reasonably assume that the travellers make the key decisions affecting their own trip, but this is not necessarily true for freight movements.
- *Use micro-simulation techniques to calibrate and forecast travel behaviour.* While this recommendation has theoretical appeal, in practice it may not be helpful. On the one hand, the enormous diversity of freight and trucking activities makes generalisations difficult, and since each firm and/or decision maker is making what we may assume to be rational decisions in their own context, expanding these to the total freight system is difficult. On the other hand, trucks are only a small proportion of the total urban traffic stream (typically 4-5 per cent), so for some applications at least, a more macroscopic approach may be more straightforward and give reasonable and useful results.
- *Link travel demand models more closely with air quality emissions models.* Trucks are a small but significant contributor to urban vehicular emissions (Nelson, et al, 1991), but if it is desired to incorporate truck emissions into a general transport emission policy analysis, this recommendation makes sense.

Data requirements. Spear (1994) addresses this issue under five heads:

- household activity diaries
- stated preference surveys
- longitudinal panels
- travel behaviour research data base
- detailed network information

There are analogies in each of these between person movement and freight movement. However, it would be premature to comment upon the extent to which these recommendations are worthy of adopting for freight. Our knowledge is too rudimentary about the freight sector, freight activity patterns, decision makers and the factors influencing them, and the information which we need to support policy and planning.

CONCLUSIONS AND CHALLENGES

This discussion has raised a number of suggested topics for discussion over the next few days. I would like to conclude by highlighting what I suggest are three issues worthy of serious discussion:

First, the question of data. Clearly we must not collect data for its own sake. Any data collection activity must be undertaken for clearly defined purposes (including perhaps model development), and in recognition of the contribution it can make to more informed policy and planning.

I suggest therefore that this is an important topic to consider during this Conference. What are the priority data, and how should we collect them?

We cannot answer that question in the abstract. We need to know what data are worth collecting, and how to use them in a way that will illuminate the processes we are examining. One useful way to illuminate those issues is of course to use models; that is why we have models after all.

Thus, a second question is: what sorts of models are needed to be helpful in policy and planning?

These two questions give rise to two others, which we need to address simultaneously: namely who are the decision makers, and what are the questions to which they want answers?

A third area which I suggest is relevant to this Conference is that of a specific class of model, which is particularly cogent in the freight field, and that is in the area of General Equilibrium analysis.

Many of the benefits of an improved freight system accrue to the wider economy (and for that matter, many of the disbenefits are also outside the transport sector). An analytical approach which looks only at user benefits (and disbenefits) is probably acceptable in the area of person movement, but is less so in the freight field. The freight sector is important to a region's competitiveness and economic viability, and increased freight efficiency can lead to broader economic gains. As Willeke (1992) has noted, "the vital core of the matter is the extension of production and consumption possibilities brought about by the transport system." A partial equilibrium model cannot capture these gains.

Moreover, General Equilibrium analysis yields results that are arguably more robust and more meaningful than partial equilibrium models such as cost-benefit analysis. The latter are concerned with concepts of consumer surplus, and often include valuations based on willingness to pay or other shadow prices, such as the value of travel time or the value of a human life in an accident (Wohl and Hendrickson, 1984). By contrast, General Equilibrium models are concerned with macroeconomic variables such as the effects on National, State or Regional Product, the balance of trade, or employment, which relate more closely to the real purposes of infrastructure investment.

An important challenge for this conference therefore is to consider whether and how to apply general equilibrium models in the analysis of the effects of urban freight.

ACKNOWLEDGMENTS

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3. FWHA INTERESTS AND ACTIVITIES IN URBAN GOODS AND FREIGHT MODELING

Mr. Dane Ismart
Federal Highway Administration
Washington, D.C.

The beginnings of the Federal Highway Administration's (FHWA) interest in freight planning and forecasting became evident about 25 or 30 years ago. At that time we produced a large number of research and policy documents on freight planning. We never came in and implemented much of this information as far as the metropolitan planning organizations (MPO) or the States were concerned. There were a number of reasons why the recommendations from these reports were not implemented on a nationwide scale. The three major reasons were:

1. No one knew what they were going to do with the information once they had it finished. They did not see the purpose of it or how it related to transportation planning in general. So, one of the things Ken Ogden said yesterday is important. We need to make sure that what we are dealing with are issues that are relevant to State DOTs and MPOs.

2. We did not have much data. We could not find the data and it was not readily available in a form that was useable by planners.

3. If you review the documents from this time period, it is evident the researchers used extremely sophisticated and complex models. In most cases the transportation planner in the field had no idea how to use them. In addition they were expensive to operate and required a large amount of time to obtain significant results. These are some of the mistakes we made in the past 25 or 30 years, when we certainly were involved with freight planning.

Some topics in planning like land use and highways receive constant attention. Other topics, like freight planning and forecasting appears like a series of waves. It appears they receive significant attention in cycles of approximately 25 - 30 years. Each time has brought about renewed interest in a given topic (at least this is true in the United States). This time the rekindled interest in freight planning and modeling was generated by ISTEA. I think we have to give credit to ISTEA. The ISTEA policy indicates that federal agencies are concerned about the movement of both people and goods. The policy statement also indicated that state wide planning and metropolitan planning shall consider freight.

The problem is that the MPOs and State DOTs have come to us and said "what is freight planning? How do we do it? What does it look like? Over the past few years we have begun to develop a research and policy program to determine specific policy and program direction for the States and MPO's. As part of this conference we should look at some of the results of these efforts. We should ask, are we going in the right direction and what future direction should we go on a technical analysis basis ?

To help planners and decision makers develop effective policies and programs and make better choices, the FHWA Statewide and Intermodal Planning Division started a significant freight related research program For example, we have the CUFS manual. "CUFS" stands for the Characteristics of Urban Freight Systems. This manual includes every piece of comparable information that deals with the characteristics of freight transportation. It is being developed at the University of Tennessee by Arun Chatterjee and Fred Wegmann. The CUFS manual is designed so that an MPO or State could use a default value to make a preliminary determination of the impact of a freight project rather than undertaking an expensive survey to obtain precise results when a general number would be more than adequate. This is similar to what is done in metropolitan planning.

We also have a study relating freight transportation to air quality. It is being directed by Rich Kuzmyak. The project should provide estimates of the emissions reductions that we are going to need to address. This is important because in many cases, emission reductions have a direct tie-in with the funding allocations that we may have with a project. It is something that has not been available. We believe that this report is going to take the form of the research done with travel demand management (TDM) options.

The third project is the Quick Response Freight Planning Guide Book. It is being developed by Harry Cohen, Debbie Mattherly and Art Sosslau at COMSIS and Alan Horowitz from the University of Wisconsin. This manual is similar to the quick response for metropolitan planning. The manual will include, quick and simple procedures to evaluate site impacts such as new truck terminals; or intermodal freight facilities; forecasting procedures and corridor analysis. For example, how do we analyze the effects of a freight bypass in a major metropolitan area? Or how do we estimate the impacts from a given number of truck movements in an interstate corridor?

We also have a major research effort underway on statewide transportation planning. We will be developing a series of guide books. The guide book will deal with the 10 or 15 factors that we think are most pertinent in statewide planning. The guide book should be on the counter of every statewide planner in the country. If a particular issue comes up and the planner says, how do I look at economics, or how do I look at land use, or how do incorporate land use into statewide planning? The manual should help get the planner started on the answer to the question. The 30 to 40 pages of material in each manual will provide planners with a guide book and a guideline of what to do.

There are a number of research projects that have been completed.

- Russ Capelle's Guide book on management systems and how to implement it. Quick, simple and easy to use.
- Bob Czerniak's work on the use of performance measures by State departments of transportation is also informative.

Not only do we have to come up with policy and program research, we also have to take into consideration the role(s) of the management systems. For example, there is an intermodal management system which can be used for both passengers and freight. Many states are using the intermodal management system as their freight planning process.

Another topic that should be considered at the conference and one which is of particular importance to States and MPOs is funding eligibility. For the first time there have been small break-through in the use of federal aid for freight related projects. There are still some restrictions, but MPOs and States are seeing opportunities where they use Federal aid for their freight activities. They need procedures and methods to compare and set priorities between freight projects and other types of transportation projects. These include transit capacity improvements, traffic operations, safety, and bridge replacements to name just a few.

The states and MPOs are faced with the development of STIP (State Transportation Improvement Programs) and Transportation Improvement Programs (TIP) in their metropolitan areas. Decisions have to be made where federal, state and local funds should be allocated. Now, they have new flexibility and in some cases can have freight projects.

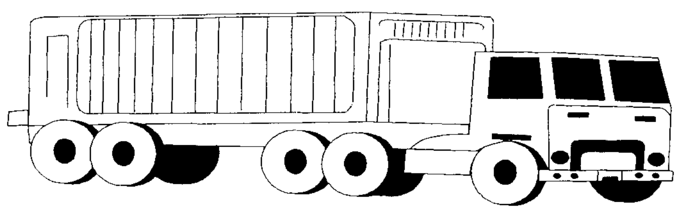
Again, I have to note Ken Ogden's paper and how much I am in agreement with what he said. I do believe that the key problem is defining the issues. This conference should help FHWA and you look at the technical procedures that we are going to develop and use. Always keep in the back of your mind what Ken Ogden indicated. What are we trying to get at? Is there really a problem? If we know what the problem is, then we can define the technical procedure. There will probably not be one technical procedure for freight planning. We agree that the procedures will have to be tied to issues.

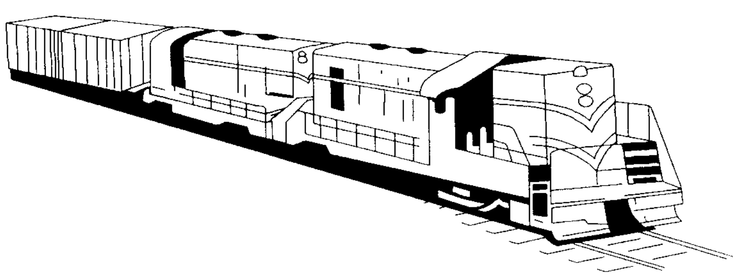
The final thing I have to say about freight planning and freight modeling as far as FHWA is concerned is that we are not interested in complex models. We simply are not interested in it. It is something that others can do maybe at a later date. Right now, we can barely crawl toward solutions and that is what we are trying to do with the freight industry. Besides going ahead and trying to run, why not figure out how to crawl first. We have to keep it simple. Remember, the people for whom you are doing this work and how your procedures relate to them. They are State and local officials that have limited resources, limited time and limited knowledge in the planning industry. It is almost like a cookbook or a formula that you are going to have to give them.

I know this from going around the country. I have probably been in every state four or five times and probably more than 200 MPOs. In many cases people thought the quick response method was the most technical procedure they have ever imagined using. So keep that in mind when you come in with your simulations and your input/output models; all I can say about input/output is -- it goes in one ear and comes out the other.

If we keep our focus issue oriented then we will not repeat the mistakes that we made 25 years ago. I hope that all of you will keep that focus and make sure the conference generates specific, technical recommendations. At the end of the conference we should have a better idea of the directions we want to go with policy development and future research.

CONFERENCE TWO PRESENTATIONS





4. PRESENTATION
FREIGHT FORECASTING: THE CONTEXT

Alan J. Horowitz
University of Wisconsin-Milwaukee
Civil Engineering and Mechanics

INTRODUCTION

Last night when I was listening to Ken Ogden's presentation, my thoughts turned to centipedes. Not that Ken reminded me of a centipede, but his presentation reminded me of one proverbial centipede that when asked how he walked he never walked again. I believe we are in a similar situation when attempting freight forecasting. When we start thinking about the complexity of the problem we give up.

There may be solutions to the daunting complexity. There may be ways in which we can simplify the concepts to bring us closer to a methodology that can help plan freight movements in future years. When Bob Czerniak asked me to make this presentation, he asked me to lay a foundation for the later speakers -- to talk about approaches to forecasting that planners have been taking on the passenger side as well as approaches planners are taking on the freight side. I hesitate to say that I will be able to lay a complete foundation; perhaps I can pour the footing, maybe get it reasonably straight and lay part of one course of bricks. Then I must leave it to the following speakers and yourselves to fill in the remaining parts of the foundation.

This presentation takes the viewpoint of a practitioner when reviewing past activities. And, as practitioners often do, I will look skeptically at much of the research that has been reported in the professional literature.

One goal this presentation is to build a commonality of vocabulary among us. At the risk of boring those of you who are very familiar with basic concepts of travel forecasting, it is necessary to go through the fundamentals -- to place us all on an even footing concerning what we are currently doing on both the passenger side and the freight side.

When I first started looking at freight issues, I wanted to know what the sages of our discipline had to say. I went to some of my favorite books on my shelf. One document I have read cover-to-cover is NCHRP #187, which is the quick response manual for urban travel forecasting. It was developed about 18 years ago. That document is essentially silent on freight forecasting. This is not unusual. Some of the more important textbooks for graduate level or advanced undergraduate courses in our field (I will not name the authors for fear of implicating them in a conspiracy) also fail to mention freight forecasting. Then, there are monographs specifically devoted to travel forecasting. For instance, Adib Kanafani has a very nice book on travel forecasting with one whole chapter devoted to commodity flows and freight issues. I would describe that chapter as suffering from a multiple personality disorder.

The chapter is divided into about 8 sections, few of them relating to each other and none of them pointing solidly in any one direction. The most telling book I found was written by Peter Stopher and Arnim Meyburg. This book contains a very good overview of the travel forecasting process as it existed 10 to 15 years ago, just after the urban transportation modeling process achieved its current underlying structure. In this thick book they wrote exactly one paragraph on freight issues; here is a quotation that takes them off the hook but leaves us hanging. "Almost all transportation studies have tended to neglect the analysis of freight trips." End of discussion.

Also relevant are travel forecasting software packages. The user manual of one widely-used package explained that some trip purposes do not lend themselves well to the traditional analysis, so the user should provide a trip table for freight vehicle movement. No other guidance was provided.

Obviously, we have a long way to go. Not only do we need to develop freight forecasting techniques but we need to get them into the hands of practitioners. I have 3 goals for this presentation.

a. Provide an overview of passenger travel forecasting.

b. Describe a brief survey of current methods for urban freight forecasting.

c. Present several issues relating to integration of freight and passenger models.

Conventional Passenger Forecasting

As I go through some of the steps of passenger forecasting, I will try to indicate which ones are critical to the freight issues. I will also present a nonsystematic survey of 5 methods for doing urban freight forecasting. Lastly, I will add 10 technical questions to the 36 questions that we have already accumulated in this conference. I shall also give examples from various studies around the country, including the Southeastern Wisconsin Regional Planning Commission, which has been on the forefront of travel forecasting over the last 30 years, the Kansas Department of Transportation and the Delaware Valley RPC.

There are two broad styles of travel forecasting being used today. The first style takes default parameters or old parameters and then adjusts the model in ways to better match reality. The second style is to do a fresh statistical calibration, involving new survey data, statistical analysis expertise, and very high powered models. Regardless of the style, just about all of the metropolitan planning organizations in the United States do their region-wide travel forecasting using what is referred to as the four step process. The four steps are trip generation, trip distribution, mode split, and trip or traffic assignment, as illustrated in Figure 1. Figure 1 includes a feedback loop to trip generation. I suggest that these same 4-steps will still play a role in freight forecasting, as

well.

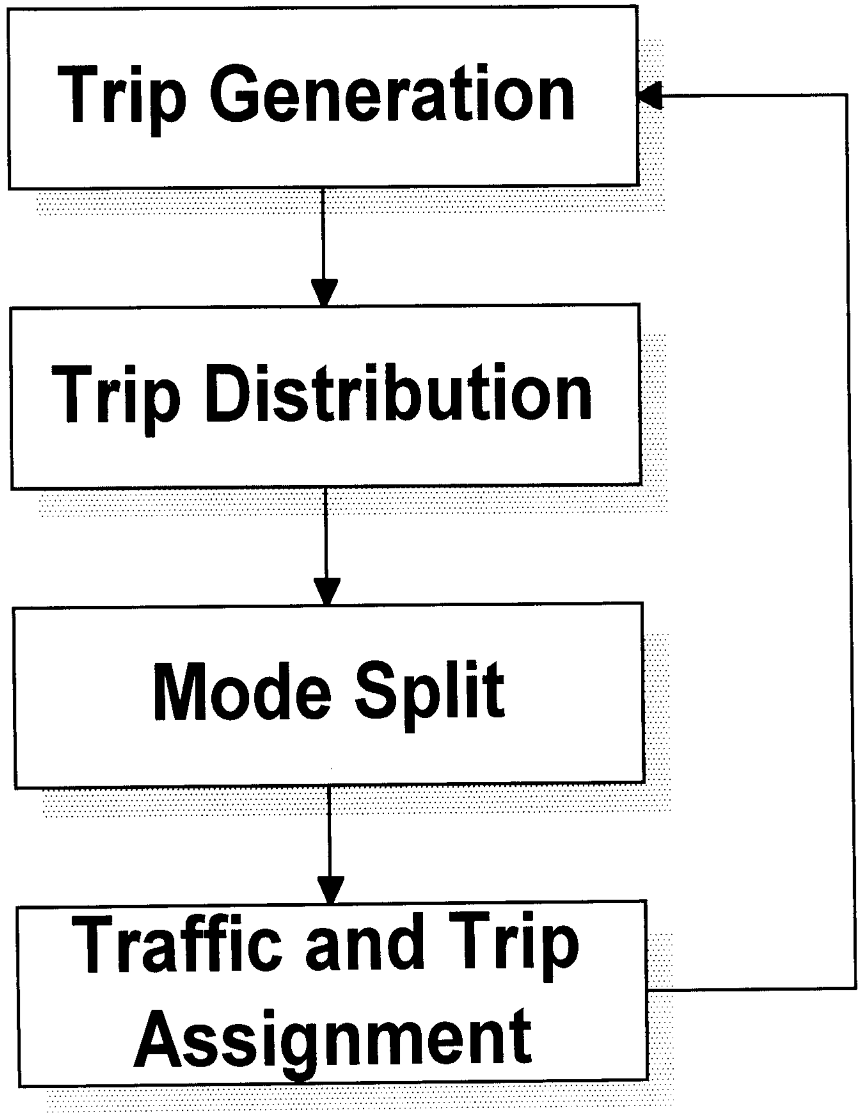


Figure 1 The Four Step Process

All applications of the four step process require a network to show the streets, intersections and zones of our region. As seen in Figure 2, streets are represented as links and intersections and zones are represented by nodes. Zonal nodes are called centroids.

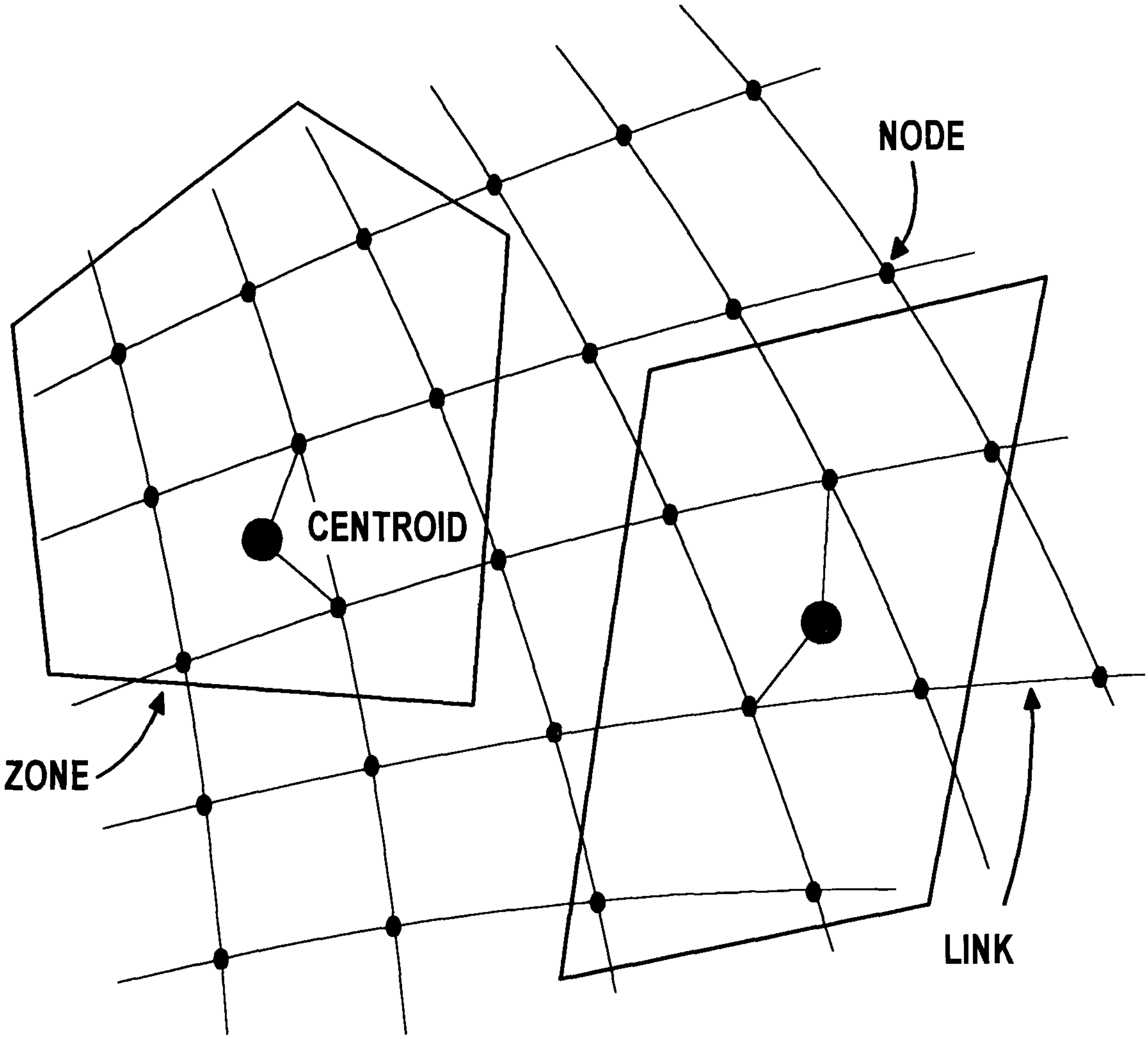


Figure 2 A Network Showing Links, Nodes, Centroids, and Zones

Trip generation is the start of the computational process, as indicated by Figure 3. Trip generation finds the number of trips produced within each individual zone (sometimes called traffic analysis zone or TAZ) and the number of trips attracted to each individual zone. Every trip has two ends: a production end and an attraction end. Trip productions occur where the trip is conceived and trip attractions occur where the trip purpose is satisfied. Unfortunately, these nice definitions of productions and attractions do not apply very well to freight issues.

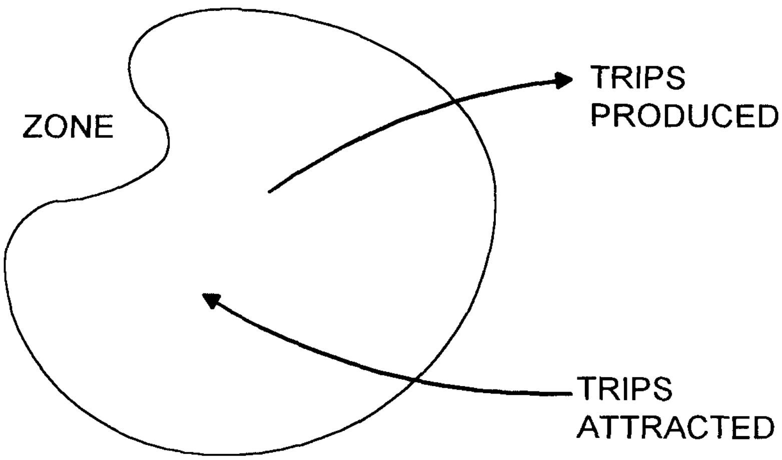


Figure 3 Trip Generation

Trip generation is performed for each of several different purposes, typically home-based work, home-based other, and nonhome based trips. In addition, it is often necessary to break out specialized trip purposes. For home-based trips, trip productions and trip attractions are estimated by distinctively different sets of equations. Nonhome-based trips are handled somewhat differently. Here are the actual trip generation equations for the nonhome-based trip purpose in southeast Wisconsin.

NHB Productions = 0.29 (Households) + 2.38 (Retail Employment)
+ 0.76 (NonRetail Employment)

NHB Attractions = 0.21 (Households) + 3.11 (Retail Employment) +
0.66 (NonRetail Employment)

There is one equation for trip productions and another equation for trip attractions. They look very similar to each other in structure and in the magnitudes of their parameters. There is one term each for households, retail employment, and nonretail employment. As will be seen later with freight trip generation equations, the production end of a trip and the attraction end of a trip have similar characteristics.

The second step in the process is trip distribution. This step determines the number of trips that go from each production zone to each attraction zone. Figure 4 shows interzonal trips, for example T12 from zone 1 to zone 2, and intrazonal trips, for example T22 for trips staying within zone 2. There are a number of available methods for trip distribution.

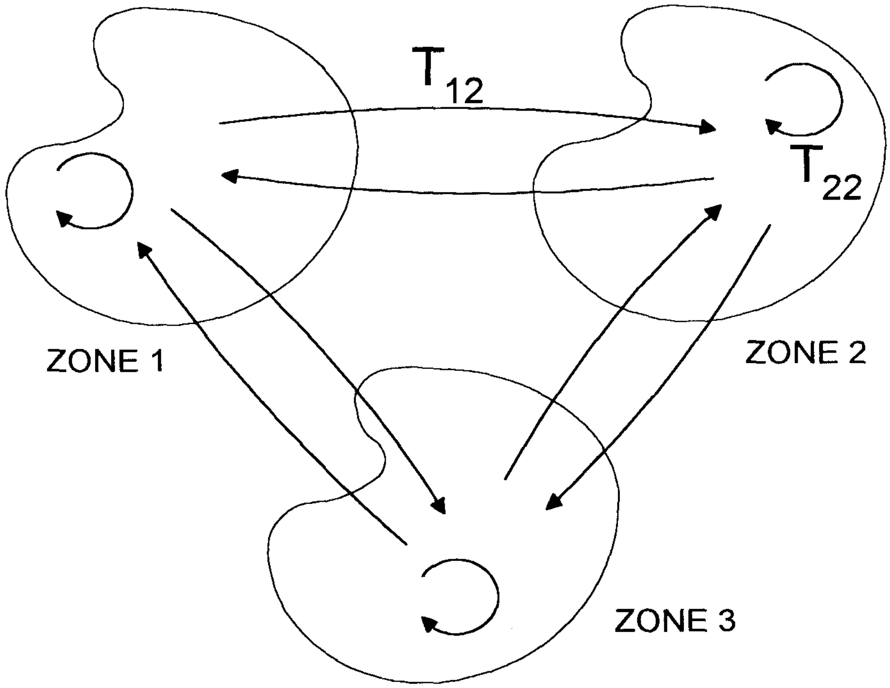


Figure 4 Trip Distribution in a Hypothetical 3-Zone City

The most popular method of trip distribution is the gravity model, as illustrated by Figure 5. This figure is not intended to be demeaning to the state of New Mexico; the states are just drawn approximately in proportion to their population sizes. There are 5 states moving clockwise from the left: Wisconsin, Iowa, New Mexico, Arizona and Minnesota. New Mexico, having the smallest population, is the smallest of the five states on this figure. There are two aspects to the gravity model. The first aspect is the distance between the two interacting areas. For example, observe the freight flows from Wisconsin to Iowa or Minnesota or New Mexico or Arizona. The greatest flows occur between Wisconsin and Minnesota. After all, Minnesota is a fairly large state and it is close to Wisconsin. There is a very small flow between Wisconsin and New Mexico, because New Mexico is a small state and quite distant from Wisconsin. We use the gravity model for trip distribution on the passenger side. You will see that we can use the gravity model on the freight side, as well.

Figure 5. Application of Gravity Model to Interstate Commodity Flows

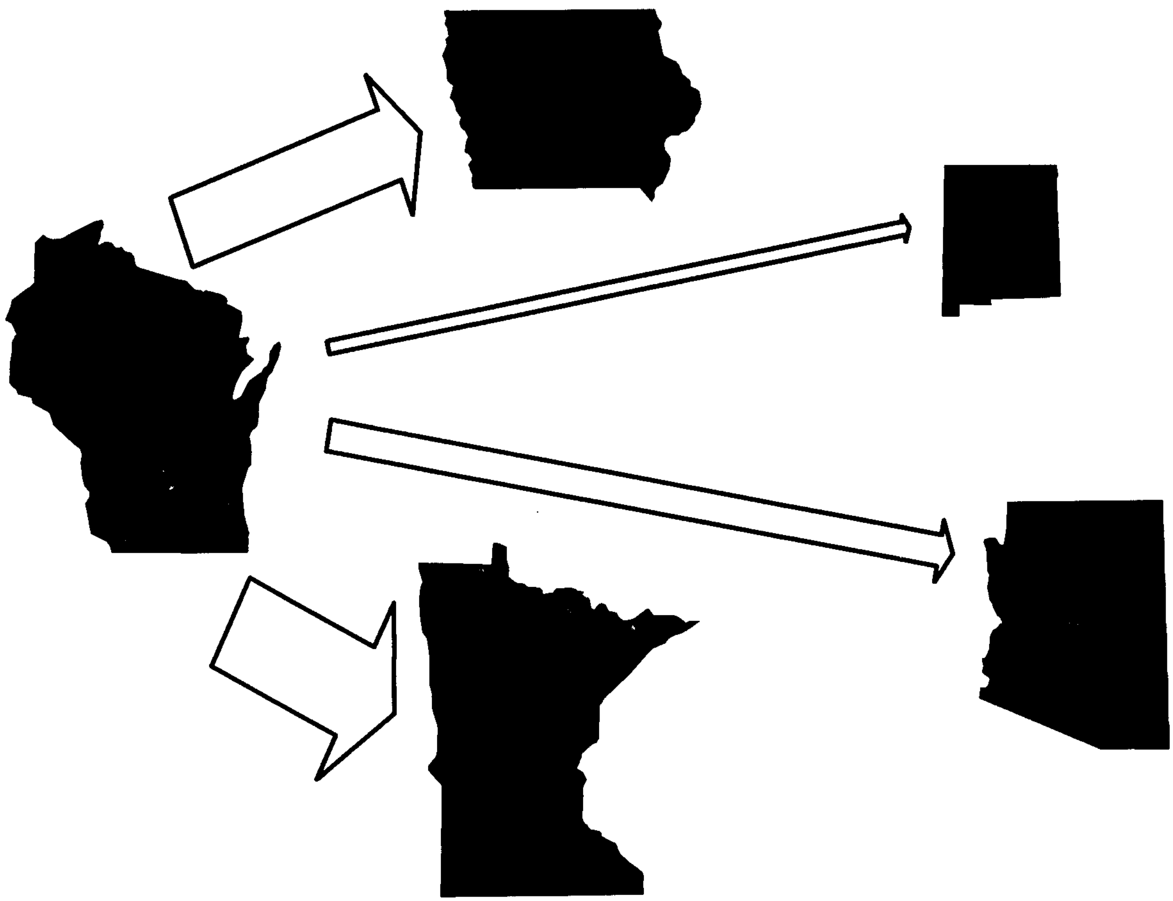


Figure 6 illustrates the mode split step, as typically performed for passengers travel. The mode split step occurs after trip distribution and before trip assignment. It takes the number of trips going from production zone 1 to attraction zone 2 and then splits them across the various travel modes. In Figure 6, which shows passenger travel, trips are split across automobiles, buses, and walking. It is also necessary to deal with automobile occupancy, either as part of the mode split step or as a separate step later in the process.

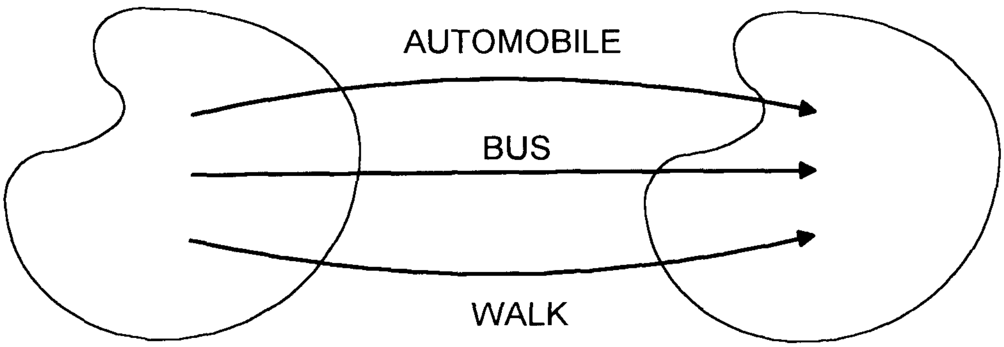


Figure 6. Mode Split between Two Hypothetical Zones

The last big step in the passenger travel forecasting process is traffic assignment, as illustrated in Figure 7. An elementary application of traffic assignment finds the shortest path between an origin zone and a destination zone, then assigns all trips to that shortest path. A more advanced traffic assignment would introduce equilibrium concepts, whereby congestion may cause diversion of trips to alternate routes.

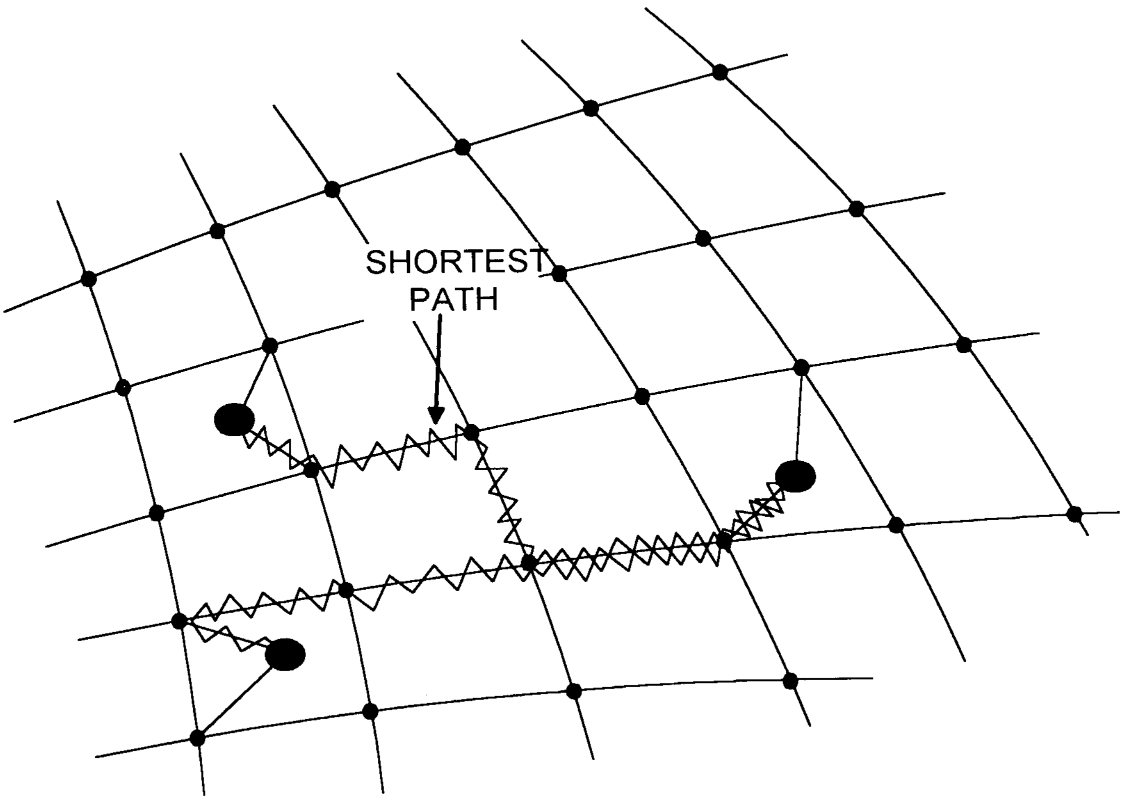


Figure 7. Traffic Assignment of Trips between Two Pairs of Zonal Centroids

Beyond the four traditional steps in the process, there are 8 or 9 additional important steps in most of the travel forecasting models that we tend to ignore in elementary discussions. Many of these steps are small, but critical. For instance, it is also necessary to worry about time of day and direction of travel, which are particularly relevant to freight planning. On the passenger side, it is necessary to estimate traffic delays expected on our road system, such as uninterrupted delay along road segments and interrupted delay at intersection approaches. Usually planners try to be consistent with widely accepted delay relations like those in the 1985 Highway Capacity Manual. In addition, delay calculations must be consistent with the time period of analysis (e.g., 1 hour or 24 hours).

Another seldom mentioned aspect of the travel forecasting process relates to combining all the steps so they work well together with appropriate feedbacks. Right now most MPO's in the United States are using software packages that do not lend themselves very well to feedback, so ad hoc methods have been employed. However, there are a few excellent methods available to us. The more interesting feedback methods are based on mathematical programming concepts. For example, Susan Evans developed a mathematical programming method in the early 1970's, as part of her doctoral dissertation, that originally showed great promise but has not seen extensive implementation. However, there is another method in wide use, derived from Evans' work, which is conceptually similar to loading trips to the network incrementally (e.g., first 10%, then second 10%, etc.) It is a clean algorithm for equilibrium solutions, combining all of the steps using travel time, typically trip distribution, mode split, and traffic assignment.

There has been recent interest in adding land use forecasting to the four step process. Land use plays a large role in freight forecasting as well as in passenger travel forecasting. A land use step tells us how people relocate their activities as the transportation system improves or degenerates. Important to freight forecasting, a land use step also tells us how the location of businesses might change in response to transportation system changes.

A full discussion of models must also include the concepts of calibration and validation. Their importance depends on data availability. Are we simply touching up the model to better match reality in terms of traffic counts, or are we doing a full-scale statistical estimation of the many parameters of the model? The fundamental purpose of validation is to determine whether the calibrated model is acceptable. What is acceptable? There are many opinions; I do not believe we have totally resolved the issue of acceptability for passenger forecasts, much less for freight forecasts.

Five Methods of Freight Forecasting

At the risk of oversimplification, there are five methods of urban freight forecasting, ranging greatly in complexity:

Method 1. Commodity Flows;

Method 2. Do Nothing;

Method 3. Adjust NHB Travel;

Method 4. Factoring an Existing Trip Table; and

Method 5. Selected Steps from the Passenger Process.

Method 1: Commodity Flows. The most complex approach involves forecasting commodity flows, and it is well represented by NCHRP Report #260, a technique for state-wide freight demand forecasting. This report has been available for a number of years, but it is difficult to find examples of applications. Agencies have shied away from NCHRP 260 because of its complexity, but there is one recent application that will be presented later.

NCHRP 260 recommended trip generation by commodity. To help trip generation we should use economic forecasting techniques, such as input/output analysis or shift/share analysis, to identify trip generation characteristics at both trip ends -- the attraction end and the production end.

NCHRP 260 suggested that trips should be distributed in manner similar to the passenger forecasting process. There are two methods: historical patterns of travel or the gravity model.

Mode split is most complicated. The author provides many diversion curves based on cost differences between the modes. A very long section in NCHRP 260 deals with how to estimate the cost for each mode.

Ultimately, the amount of commodities must be converted into truck load equivalents, and then those truck load equivalents are assigned to the highway network.

The Wisconsin state-wide model, as presented at this conference by Randy Wade, adopts a similar philosophy to NCHRP 260, but differs in important details. NCHRP 260 seems to be best when applied at the state level or, perhaps, at the national level, but it is not as suitable for forecasts at the local level. NCHRP 260 is the most academically satisfying method, but not necessarily the method that I would endorse if I were in the process of recommending freight forecasting techniques to an urban area.

Method 2: Do Nothing. The do nothing method is on the other extreme. Before you conclude this is a joke, I can assure you that it actually works. I know it works because there is virtually no mention of freight in my software package, QRS II. Many people who use QRS II ignore freight; no one seems to be the wiser and no one seems to be particularly unhappy. Hence, there is much anecdotal evidence that doing nothing is actually a very good procedure. The reason stems from the typical approach of combining validation and calibration, while placing a heavy reliance on traffic counts of all types of vehicles. By combining calibration and validation, discrepancies between the model and reality are eliminated through parameter adjustment. One of those discrepancies is the unmodeled freight component.

In addition, during the calibration and validation process there is a tendency to nail down very tightly certain types of trips: external-to-external trips; internal-to-external trips; and external-to-internal trips. Left over are internal-to-internal trips, which on the freight side (it may be argued) are less important and can be calibrated into the forecast by just manipulating our trip generation parameters.

Method 3: Adjust NHB Travel. Adjusting nonhome-based travel (NHB) is only slightly more sophisticated than doing nothing. This technique involves adjusting the parameters for the NHB equations in the trip generation step. The rationale for this type of adjustment is the similarity between NHB trip generation equations and freight trip generation equations. For example, consider this freight equation from SEWRPC.

Truck and Taxi Trip Ends = 0.05 (Population) + 0.11 (Retail Employment) + 0.17 (NonRetail Employment) + 234

Except for population instead of dwelling units, the truck equation is similar to the NHB equations presented earlier. Consequently, adjusting the NHB parameters will probably give you a better forecast than adjusting all trip purposes together.

Method 4: Factoring an Existing Trip Table. The fourth method, and the one used in southeastern Wisconsin, is to apply factors to an existing truck trip table. Originally, SEWRPC surveyed a sample of operators and shippers to determine the pattern of truck travel in the Milwaukee area. Then they expanded the sample trip table to give a base-year truck trip table, which accounts for all truck and taxi travel. For future-year forecasts they factored the base-year trip table according to the Fratar method. The details of the Fratar method are not particularly interesting, but the essence of the method is to take an existing trip table and tweak it to make the row totals and the column totals equal to our trip generation results. Unless the future-year trip generation information differs radically from the base-year, the Fratar method will preserve the major underlying structure of the original trip table.

SEWRPC used the truck and taxi trip-end equation (seen earlier) to give the desired row and column totals. This is not a bad equation for this application, except for its disturbingly large constant term, 234 trip ends. This term accounts for roughly 200 thousand trips per day in the Milwaukee area, probably too many for a really good truck forecast. SEWRPC might have been better served by additional explanatory variables in its regression analysis. Nonetheless, the basic technique is valid.

Method 5: Selected Steps from the Passenger Process. Examples of this technique are the Kansas statewide model, which will be presented later, and the Philadelphia model from the Delaware Valley Regional Planning Commission (DVRPC). DVRPC performed direct trip generation to individual modes, yielding separate equations for light trucks, heavy trucks, and taxis. The underlying variables for their trip generation equations were levels of activities: dwelling units, retail employment, nonretail employment, manufacturing, and transportation services. Trip distribution was performed using the gravity model, which they found to provide acceptable results. The measure of separation in the gravity model was over-the-network travel time between each production zone and each attraction zone.

The "Quick Response Freight Manual", currently under development, is adopting a similar approach. This manual is also being heavily influenced by a recent truck forecasting effort in Phoenix.

Hybrid Approach: The Kansas Statewide Model. The Kansas statewide model was developed under contract to Kansas DOT, and is documented in a report, "Microcomputer Transportation Planning Models Used to Develop Key Highway Commodity Flows and to Estimate ESAL Values." ESAL stands for equivalent single axle loads, and it is a widely used indicator for predicting pavement life. The Kansas model is a cut down version of NCHRP 260. It is particularly nice, being less ambitious, and it was able to eliminate some of the cumbersome aspects of NCHRP 260.

The Kansas statewide model was implemented with an off-the-shelf forecasting software package. The model concentrated on trip distribution and traffic assignment. Because of the need for ESAL values by road segments, the model used a large network of 2200 links. Zones were 105 counties. In addition, there were 68 external stations at the borders of the state. Trip generation was performed by commodity, principally agricultural: wheat; corn; sorghum; soybeans; and boxed beef. Commodities were split to trucks by historical percentages rather than by the elaborate diversion curves of NCHRP 260. Amounts of commodities were converted to truck loads by rule. For example, one of the rules says there are 850 bushels of grain per truck load.

In the Kansas statewide model, distribution was segregated by commodity and by whether the trips had external or internal locations at their ends. For internal-to-internal trips, empirical trip tables were hand built from local data on commodity movement. External-to-external trip tables were created from cordon count data at the borders of the state of Kansas. The gravity model was used for those trips left over: internal-to-external trips and external-to-internal trips.

Kansas used three different all-or-nothing assignments to load the network with trucks. The three different assignments differ by their measures of impedance; a final assignment was found by averaging the link volumes. Kansas seemed happy with the results, as they were intuitively satisfying, even if there were not sufficient data for a full validation.

The Kansas statewide freight model illustrates the importance of having validation data in place. With good traffic counts they would have had less trouble establishing impedances and calibrating the gravity model for external-to-internal trips and internal-to-external trips.

Issues in Urban Freight Modeling

This review of conventional techniques of passenger and freight forecasting leads to ten questions to be added to those of this conference.

Question 1. Is there one step in the process that controls the structure of the remaining steps? I suggest that the one step will either be trip generation or mode split.

Question 2. What is the role for commodities? Do we even need commodities or can we bypass commodities altogether by doing direct generation of truck trips? If we can do direct truck generation, what are our purpose definitions?

Question 3. Should we differentiate between vehicle types, and if so should we have standard definitions of vehicle types that can be applied in different urban contexts?

Question 4. Should our trip generation equations be based on activities or based on land use information?

Question 5. How could we best use the Highway Capacity Manual? Are the passenger car equivalence (PCE) factors contained in the HCM useful in our traffic assignment step?

Question 6. How can we transfer parameters from one city to another to avoid surveys? How well do parameters in one city match the freight characteristics in another city?

Question 7. To what extent are gravity models suitable for trip distribution?

Question 8. How can we best integrate statewide freight information in urban models?

Question 9. How can we best organize a data collection effort for truck trips and for special truck trip generators?

Question 10. How can we best to include freight into full network equilibrium models?

Closure

Unfortunately, we have not yet done much to fix our image of being centipedes trying to simultaneously move 100 legs. I would like to believe that with a little bit of work we can again regain our ability to coordinate our thinking on freight forecasting. We may not now be crawling, but maybe by the end of this conference we can be moving in a forward direction.

Question

Generally what procedures do you think are most applicable to MPO's, and where does site impact analysis fit into the procedures?

Reply

Site impact assessment does not really fall into one of these categories. I would describe site impact assessment as a cut down of the traditional 4-step travel forecasting process.

For MPO's, I would recommend either of the last two forecasting methods. Everything depends on the type of available data, the budget, and the type of questions to be answered. The best two strategies for most communities are building a trip table from survey data and then extrapolating that trip table into the future or using selected steps from the 4-step process.

5. PRESENTATION DIRECTIONS IN FREIGHT DATA

Joe Bryan
Reebie Associates
Greenwich, Connecticut

INTRODUCTION

The topic of my presentation is directions in freight data. First, I will provide some orientation to freight issues. Then I will discuss data needs, data sources and future directions for freight data.

Orientation of the Freight System

The freight system is a market acting over an infrastructure. What I really want to emphasize is the word "market." The market is global. It has local segments, but the market is global. Even at the local level you see the effects of global activity; that is important to recognize. The local system contains:

1. Purely local volume - that means origin and destination, is local as is consumption,
2. Staged distribution and pick up and delivery operations (P&D),
3. Direct outbound and inbound shipping, and
4. Overhead volume.

At the local level are the origination and destination of trips that are going to be local, but production or consumption occurred outside the local area. In other words, the goods are being brought in or the goods are being shipped out. You also have direct outbound and inbound shipping where the origin is local and the destination is vice versa. You also have overhead volume. Overhead volume is two external ends, in other words, what is passing through the local area. Let me emphasize the first two areas, purely local volume and the staged distribution of P&D. High empty returns are characteristic of these elements. When we talk about goods movement, it is easy to forget that some goods movement is about the movements of empty vehicles where it is a manner of staging to the next movement. That is part of what has to be understood in terms of getting the big picture of what happens on the infrastructure.

Figure 1 is a diagram of a regional market. The graphic makes two points: first, there are known patterns about the local market that are available from commercial sources. By the examination of existing data sources you can get a good picture of some the basic things that are happening at a local level. What this graphic shows is a trading system of a satellite market. This is based on a pattern from a data base that my firm produces which is called "Transearch". There is hub market one and hub market two. Around the hub market are a set of satellites that are called communities.

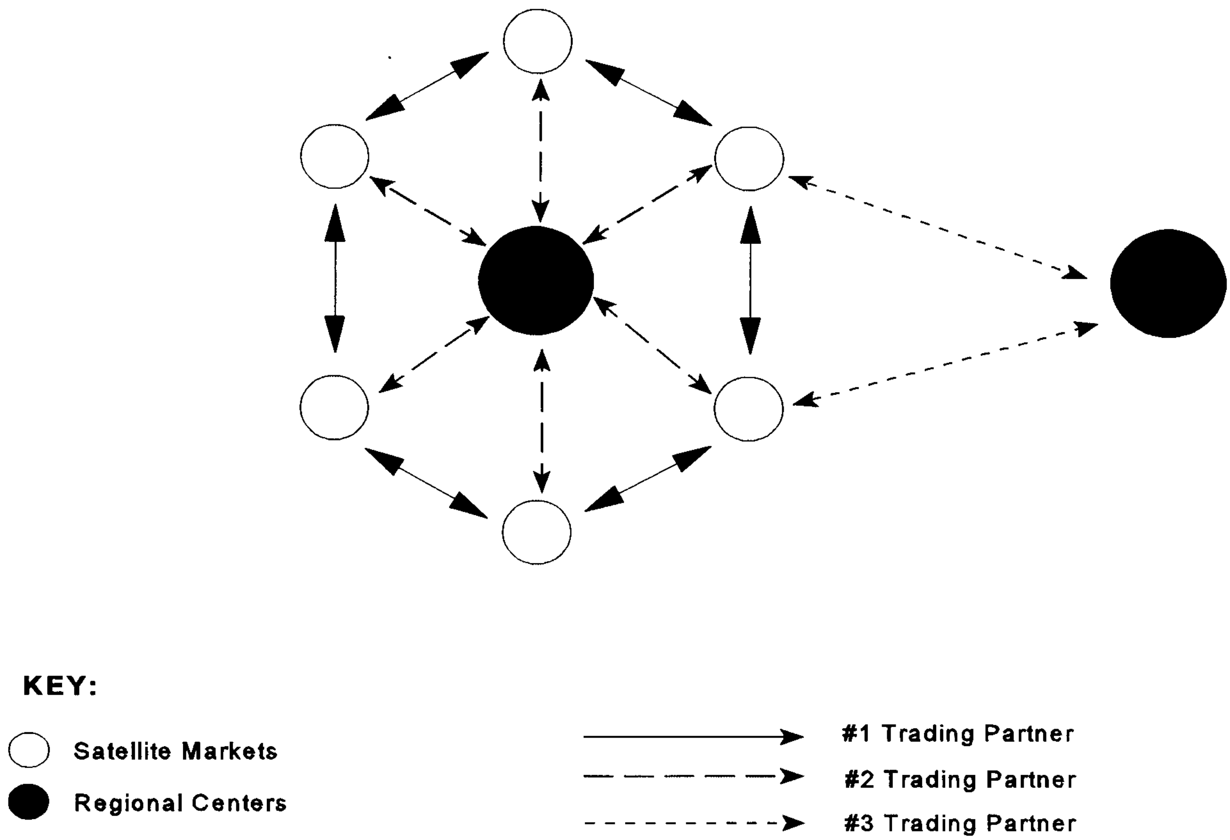


Figure 1 Schematic Function of Regional Market

The way the trading pattern works is that markets trade first with each other. Second, they are trading back to the local hub. Finally, they are going out to other hubs. Local markets, according to our information take the full load drive in and truck load type of operation. From the commodity flow survey, looking at 1993 information and total tonnage for all modes, about three-fourths of the traffic runs 250 miles or less on a tonnage basis. This makes the local market important.

Orientation to the market for freight data is illustrated in Figure 2. Information has a market. There are two segments. The market says something about how you can generate information, how you are going to have sources, and how you are going to have sources, and how you are going to have the appeal of information. There are two segments, one of the segments is government and the other segment is carriers. Like any market, there is a typical market life cycle to it. Market life cycles follow the "S" curve. It goes up from nascence to maturity. Nascence is the beginning of things and maturity is after all the growth phases are out of it. Government markets are below. Carrier markets are above.

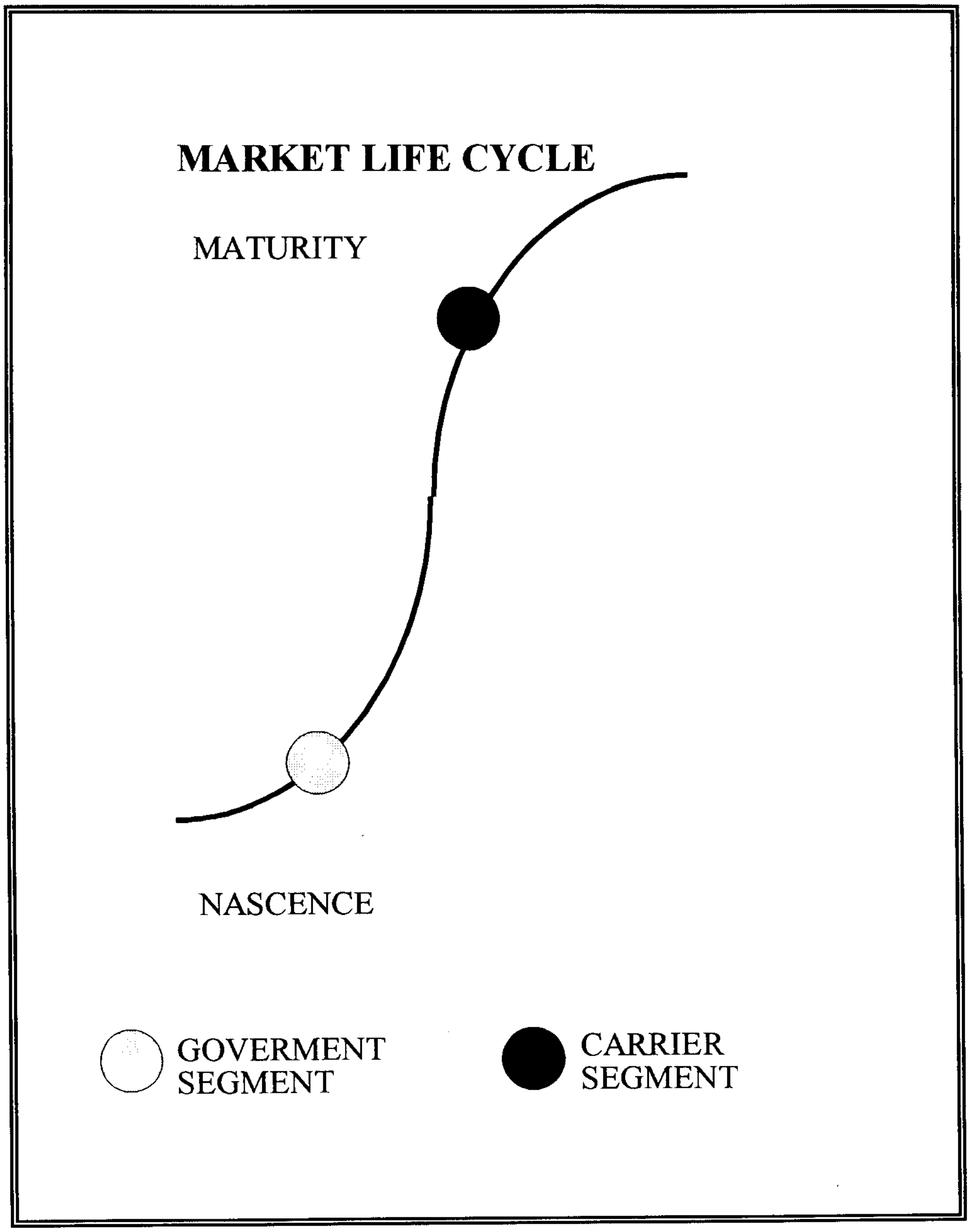


Figure 2 Orientation: The Market for Freight Data

Orientation: The Market for Freight Data

A quotation from the NCHRP 8-30 report states, "Most states and MPOs have little or no experience in freight planning." I think that is something most of you can say is true from your own experience. Obviously, the freight carriers are a lot further along the curve. However, they are not at the top yet. The reason is that their roles and their markets are transforming. There is modal conversion, there is an increasing, intensive drive by freight carrier customers, and the industries that make goods. They are under a great deal of pressure to improve their reliability and the speed of their transit. This pressure is to be able to do that at a lower cost continuously. These folks are under much stress and there is a great deal of innovation and invention that has to take place. They are not at the top and they need information. Market maturity has arrived and that means, "What kinds of data do you need?" What kinds of data products are going to be there? The needs and the data products are going to evolve. Where you are today is not where you are going to be in five years. The data sources are also going to evolve and the type of software is going to evolve. What is needed is something appropriate for this. That is what we are trying to provide.

Three basic questions that have to be answered: 1) What is in my region or market? 2) What is going to be there? 3) What should I do about it? To answer these questions, there are fundamental data needs as show in Figure 4. There are motivational concerns that underlay what the fundamental data needs are. The fundamental data need of government is found at the county level. You need to capture external trips and local trips. You need to develop modal information, you need to be able to get it by weights and you need to be able to get it by load units. There is a need for data concerning corridors, distance and infrastructure information. It is necessary to have data on goods and industries. You also need to be able to look at the picture both as it is now and the future. Carriers by the way have lots of information that is analogous. Motivational concerns include economic development/business development, urgency, individual diversity and decision support.

GOVERNMENT			CARRIERS
	COUNTY EXTERNAL & LOCAL TRIPS MODAL WEIGHTS & LOAD UNITS CORRIDORS, DISTANCE, & INFRASTRUCTURE GOODS & INDUSTRY CURRENT & FUTURE	ZIP CODE, SOMETIMES COUNTY ORIGINS & DESTINATIONS MODAL WEIGHT & LOAD UNITS DISTANCE, SOMETIMES CORRIDORS & INFRASTRUCTURE GOODS & INDUSTRY CURRENT & FUTURE	

Figure 3 Fundamental Data Needs

Economic Development

ISTEA opens the case for freight driven investment in infrastructure. The benefits of that type of investment accrue to the efficiency and competiveness for industry. I cannot emphasize that point strongly enough. From my point of view this is what the whole game is about. There is a direct link from the condition of infrastructure to the efficiency and competiveness of industry. Particularly as the demand for tighter and tighter service standards increases. When you have things like congestion delay, it is going to affect the reliability and the speed and the cost of the carrier who is trying to operate over that infrastructure. That translates directly into the cost and the predictability of distribution for industry. The issue of distribution is very much one of the weapons that industries in your communities are using to be able to compete in the global market. Anyone who has a Walmart in their community knows that makes a whole lot of difference.

Construction of infrastructure also requires the support of the private sector. This is a comment from somebody at the Port of New York and New Jersey. Nevertheless, many of you can say the same thing. You want the involvement of the private sector. You have to have their support. You also need to be able to speak their language. You also need to have information that is creditable to both parties.

A national commission on intermodal transportation was chaired by a gentleman named Mr. Krebs. He was the chairman of the Topeka and the Santa Fe Railway and is going to become the President of the Burlington Northern Santa Fe combined system. This system is going to be one of the largest railroads in the United States. The intermodal commission reviewed the status of intermodal transport. There is a set of conclusions you can draw by what freight data ought to do. Freight data needs very much to incorporate a national system perspective. It has to help analyze the system consequences of local conditions. You have to be able to show connectors and show their bottom line. In addition, informing government planners about freight is clearly helpful. Freight data needs to reveal the market context. It is a bigger picture. You have to be able to see what is in front of you.

The following statement is a quotation from the Vice Chair of the National Association of MPOS, "MPOs are responding to urgent needs without data and they are defining the issues without assessments." That is a problem. In other words, people are trying to work without the necessary tools. They are going to have to have tools. Data are vital but the information also has to respond to a variety of local and individual needs.

Here is a basic set of conclusions on the subject of diversity. How fine can you cut your data? Local information ultimately comes from local sources (highly local information that is). Also, local intelligence provides for sound data assembly. In other words if you understand how your local picture works, it helps to put the data together in the right way. Issues will differ by location, for example, being able to understand what is happening at United Parcel Services is important for the Louisville MPO because they have a big hub there. While it is supposedly an air hub, much of the feed is by truck.

That is not so important to somebody else in another part of the country. Everybody's issue will differ a bit. Data products need to fit the local environment. In our view, the best way to come up with a solution to this is to have an integration of data products and services to go with them.

Information helps people to work more effectively. Methods to make data easy to handle and easy to analyze are very important. Having lots of data is just not helpful if you cannot get it to tell you what you are trying to find out. The manipulation of data with compound relationships, because they are complex, is critical for scenario analysis among other things. A scenario analysis is one of the typical applications that people use with data. What happens if I do this? What happens if I do that? How can my data be twisted and turned so that it will help me to answer questions and support decisions? Data and freight modeling development are symbiotic, the better the data, the better the model. The more the model evolves, the more the data is going to have to keep pace with it. The bottom line in our view is that data and tools to work with data must be treated together.

A quick review of Federal, State and MPO data sources is shown in Figure 4. What happens at the federal level? You get excellent aggregate market totals. You also get large scale primary data collection, such as the commodity flow survey. That is a very important function. However, there are also imposed constraints on specificity and frequency. There can be legal constraints; as well as political and cost constraints.

You cannot take it down to the county level if you are generating a commodity flow survey because it reveals too much. For those who are familiar with all the major types of federal information, the commodity flow survey which will now be in its key form is going to be out at the end of November 1995. Sources include truck inventory and use surveys, and the Corps of Engineers waterborne study. A variety of import/export information, the railroad weigh bill, which is available at the state level, but at the MPO level is arguable.

FEDERAL	• AGGREGATE MARKET TOTALS • LARGE SCALE PRIMARY DATA COLLECTION • IMPOSED CONSTRAINTS ON SPECIFICITY & FREQUENCY • CFS, TIUS, EXIM SERIES, RAIL WAYBILL, COE WATERBORNE
STATE	• REGISTRATION, VEHICLE CLASSIFICATION, WIM DATA • SPECIALIZED INFORMATION ON LOCAL INDUSTRY
MPO	• VARIOUS FORMS OF SURVEY • PERIODIC INFORMATION, BUT POTENTIAL FOR A WIDE NET

Figure 4 Public Freight Data Sources

At the state level, there is registration information, vehicle classification, weigh and motion data. Weigh and motion data as they evolve are going to be helpful in particular to be able to isolate the proportion of empty traffic. If you can weigh a truck and you have an idea of the truck's tare weight, you have a very good idea of how many of those trucks are running empty. This allows you get at that part of goods movement that is hard to find. There is specialized information on local industry in most states. It is beneficial for developing a full picture of what is going on.

At the MPO level there have been a variety of surveys conducted. This is periodic information, in other words, it is not typically done every year. There is a potential for a very wide net to be thrown over what's available to know in the world. Out of the 300 plus MPOs in the United States, those bits of periodic information start to add up to a lot if it is done right.

What are the roles of commercial freight data sources? On the commercial side, we can develop proprietary, primary data. My firm for example, has an arrangement with the trucking industry under which we exchange information. We can get much truck data that we build into our data sets. We are not the only company able to generate proprietary, primary data. Second, we can integrate commercial and government sources, such as the commodity flow survey. We are also able to work that with commercial sources, for example, we have a set of high quality industrial demographic information. What are the establishments throughout the United States, specific street addresses, how big are they? The combination of that information with this information starts to let you do many things that are helpful. We also improve specificity, scope and timeliness.

ROLES

- DEVELOP PROPRIETARY, PRIMARY DATA
- INTEGRATE COMMERCIAL & GOVERNMENT SOURCES
- IMPROVE SPECIFICITY, SCOPE, & TIMELINESS
- ACT AS INDEPENDENT THIRD PARTY
- WIDEN APPEAL

FEATURES

- MODAL FLOW
- FORECASTS
- MODAL COSTS
- INDUSTRIAL DEMOGRAPHICS
- CUSTOM DATA & ROUTING
- MARKET EXPERTISE

DIRECTIONS

- MAJOR DEVELOPMENT EFFORTS UNDERWAY

Figure 5 Role of Commercial Freight Data

We do two other things that are important as well. First, we act as an independent third party. This means that we are not government, therefore, what we do is not public domain. We are also able to treat information in a confidential fashion and that helps to generate information. If you can act as an independent third party, you can attract information that is otherwise hard to get.

Furthermore, we widened the appeal for data. Remember, that I said data is a market, that means it has economies like any other market. The bigger the market, the more you can do with it. Because we can appeal to carriers, we can do more than we could if we were only able to appeal to government. Types of features that are available from commercial sources include: modal flow, forecast, and modal cost-industrial demographics. You can take any of this data and customize it, or develop new primary information or adapt the various source of information. You can customize routing and get market expertise. For those who are not familiar with the freight business, there are people available who have worked with it and can give you an intelligent understanding of what you are looking. You do not have to do it alone.

There are some major development efforts underway for urban goods data. First, a complete view of the local market calls for local information, but I will also say that local information by itself gives an incomplete view. There have been a variety of surveys done, but I am not aware of shipper data being collected at the MPO level. I suggest you try collecting shipper data as a useful addition to the sorts of surveys you are already doing.

Who ultimately benefits from freight driven investments and infrastructure? It is your local industry. That is economic development. You need them involved. This is outreach. It also starts to attract information. Because they are feeding you information, it is helpful to build your credibility. This can work two ways: it helps to build a consensus about what ought to be done and it helps to get people to agree that information you are working with is the right information.

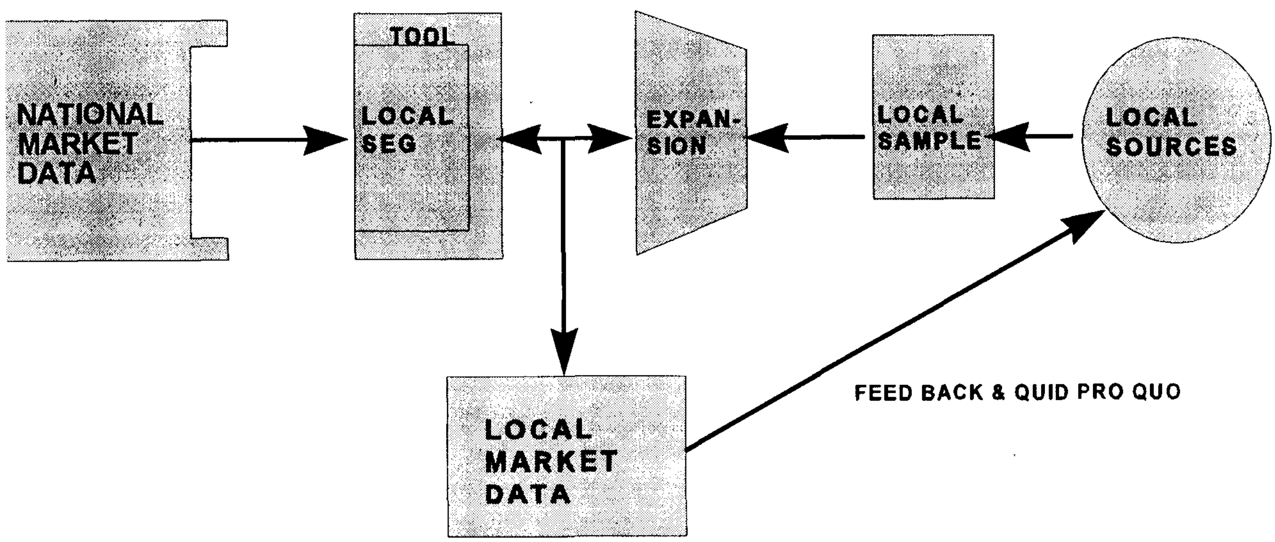


Figure 6 Development of Local Market Data

Furthermore, from sources like shippers, you are going to obtain better performance measures. There is no way that you are going to be able to get, say from a roadside survey, any information about serviceable liability. On time performance, is one of the primary things that the people who buy freight are seeking. You will not have any information on that if you are unable to reach out to this type of source.

You can also get data quality if you approach this the correct way as shown in Figure 6. You need a quid pro quo. In other words, if you want something, you should be returning something; it not just going to be public spirit. Offering something in return is necessary. The standard incentive is some market intelligence. When you are gathering information from a shipper, you give him back information about the way the local market works.

I am going to break down our data by SIC and you can see how you fit it with similar industries in this marketplace. Third parties are often required for confidentiality because this is potentially sensitive information. It may not be readily available to you, but if you can work with some kind of intermediary, you can get it. There is precedence for this type of operation in the private sector. I have done it working for freight carriers as a freight carrier. We have generated information from large bodies of shippers and detailed information that reveals a great deal. So doing it is possible, if you approach it the right way. Any sample is rarely going to cover the whole range of activity. First, you get partial cooperation, in other words, even though you want to get everyone giving you information you are only going to get some.

Anytime you seek sample data; you will not obtain the full range of available information. Often you will only get partial cooperation from shippers. Furthermore, you tend to only get partial capture of modes. Let me cite a couple of examples. A shipper sends a load of freight off with Schneider National. The shipper does not know in many cases whether Schneider is going to run that over the road or whether he is going to run it through a rail intermodal system. When any one of you ships with Federal Express, you are thinking that you are buying air freight services, when in fact a large percentage is running by ground. If you talk to the railroad industry, it will tell me about your intermodal transport, who are the shippers and receivers of that type of freight and where they are located. The fact is they do not know. It is a telling comment about the railroad industry but it is also factual.

I think there are three steps to solving this problem. First, you have to take local information and combine it with national market data--it gives you the context. Second, you can work with that local information and expand it with demographic modeling. Three, accumulating a relevant body of knowledge is important. Here is an overview of how this might work. National market data is available and a segment of that is local information. What we do and what other people will do as well is to take that data and encase it in some kind of analytical tool. In our view that tool needs to be a combination of a geographic information system and a dimensional data base manager.

Building knowledge makes the independent collection of local data appropriate. No one wants to dictate how various MPOs or states ought to behave. That is the way it should be. I will say this, voluntary cooperation on some common element, can create a major data resource. Anyone who implements a survey; will design it to suit their own purpose. There are some common basic elements that they can gather. That in combination starts to provide a tremendous resource of data. This type of voluntary cooperation is going to aid in the discovery of patterns, that kind of data as it accumulates is manageable by integration with national data. In other words I have after these data points out here from half dozen

MPO studies -- how am I going to work that together, how am I going to combine it and integrate it. The type of systems that build a national data sets can do all of that. In order words, it provides an excellent mechanism and a mechanism that can extend what's learned in one place and apply it to another. So that if New York, Chicago, Dallas and half dozen other big cities and half dozen moderate size cities, as well, have done good studies, you can look at what the patterns are, integrates that with base line information and start to be able to project probably accurately what's happening in communities that have not done any work. You will improve your modeling and you will improve your information.

This is what I would recommend in terms of what common basic elements ought to be. We feel you ought to use zip codes and you ought to use SIC because they are available. The trucking industry uses zip codes as their primary geographic unit. The reason they do that is that every freight bill has an address on it and every address has a zip code. Zip codes at the five digit level are fine. They can manage their density with that type of information. The whole reason for zip codes is not that they are perfect but you can get them. The same thing is true with SIC. There is nothing wrong with collecting commodity coded information; you can bridge that between one thing and another. The SICs can be predefined or obtained from commercial data sources. You can know it up front or you can get it from them -- they will tell you. We recommend you get shipments and you get weight because shipment size relates to modal split. You want weight, because from weight you can develop a whole variety of measures. You ought to aim for standard mode and equipment categories. We feel that basic mode split of rail, truck and various subtype of trucks such as LTL and small packages is required. We also feel that being able to distinguish reapers from tank type equipment is helpful and it tracks well with the SICs. Rates are useful too. There is precedence for being able to pick up rate information. I cannot guarantee you that you can get it.

Intermodal Freight Visual Data Base

There are some major development efforts underway. We have been engaged in one called the Intermodal Freight Visual Data Base. An overview of this data base is shown in Figure 7. It is about developing national market data. Intermodal Freight Visual Data Base has as a goal - a comprehensive data foundation for freight planning that anyone can use. It is meant to be national, commercial, competitive, open ended and affordable. The competitive aspect of it means that not just one firm is engaged in this so that you will not have a single source. Open ended means that you need to be able to work with information and make it available to anybody who needs to get into it. It needs to be able to fit with a whole variety of local activities and various points of views. There is going to be much modeling done with any type of data made available. The Intermodal Freight Visual Data Base replaces much custom development with economies of scale. We have done a fair amount of work and we are not the only ones developing extensive custom data sets. They cost money. We expect to be able to provide a fundamental package for about five or six thousand dollars with extremely good quality information and extremely good specificities.

It is an FHWA sponsored initiative under the Small Business Investment Research program. We built a prototype as part of the feasibility study. The prototype worked with a comprehensive freight data base that my firm constructed for the state of California. Cal-Trans ITMS Data Center. It covers every form of freight including empty truck movements. It uses a variety of units of measure including numbers of trucks. It has corridor information and industrial information. Everything is broken out by SIC.

Everything is broken out by multiple modes, truck loads, LTL, private truck activity, plus rail, plus water, plus import/export.

- GOAL : COMPREHENSIVE DATA FOUNDATION FOR FREIGHT PLANNING
- NATIONAL, COMMERCIAL, COMPETITIVE, OPEN-ENDED
- REPLACES MUCH CUSTOM DEVELOPMENT WITH ECONOMIES OF SCALE

- FHWA-SPONSORED INITIATIVE UNDER SBIR PROGRAM
- FEASIBILITY STUDIES COMPLETED JULY, 1995
- PRODUCT DEVELOPMENT PROJECTS RECOMMENDED TO PROCEED

Figure 7 Intermodal Freight Visual Data Base

The Intermodal Freight Visual Data Base can deliver all seven of the broad requirements of customers:

REQUIREMENT	PRODUCT	APPROACH
1. Comprehensiveness	All Freight Traffic	Sourcing, Source Integration, Modeling
2. Currency	T-1 Annual Base Year ("Last Prior Year")	T-1 Carrier Inputs, Econometrics from DRI
3. Reliability	Practical Output, Process Control	Transearch Systems, Robust Measures of Change
4. Specificity	Integrated Product/Service Solution	9 Disaggregate Dimensions, 5 Forms of Refinement
5. Ease of Use	Scripted, Visual Software	Powerful Desktop Platform, Point & Click Interface
6. Compatibility	Standard Software & Data Links	Fit with Common Software, Integration of Use Data
7. Affordability	MPO Product APX $5-6K, with +/- Options	Product & Service Options, Scale Efficiencies

Some government applications of the Intermodal Freight Visual Data include: planning, input to management systems, economic development, access and safety.

Planning applications:

- Statewide Multimodal Planning data
- Inputs for Diversion Analysis
- MPO Highway Planning Data

Input to Management Systems:

- Truck Weights & Ton Miles for Bridges and Pavements
- Truck Units and VMT for Congestion and Air Quality

Economic Development:

- State and Local Industrial Patterns of Modal Use
- Common Data for Consensus Building
- Industries Affected by Policy and Program Options

Access and Safety:

- Intermodal Demand for Highway Access
- Grade Crossing Volume and Affected Industry
- Statewide Demand on Intermodal Network

6. PRESENTATION
TRANSLINKS 21 TRANSPORTATION PLAN: INTERCITY MODAL FORECASTS AND INTERACTIONS

Randall Wade
Wisconsin Department of Transportation

Introduction

This report summarizes the intercity multimodal forecasts used in the Wisconsin Department of Transportation's Translinks 21 Transportation Plan adopted in November 1994. It discusses the Translinks 21 forecasting and analysis methodology which allows consideration of the interactions among both passenger and freight modes of transportation.

The Translinks 21 Plan is unique in that for the first time the Wisconsin Department of Transportation has undertaken the preparation of a statewide *multimodal* transportation plan. By multimodal it is meant that all modes are analyzed simultaneously and interactions among modes are specifically accounted for. The Translinks 21 Plan focuses on the interactions of state intercity transportation modes. Plans prepared by Metropolitan Planning Organizations (MPOs) will address in detail the state's urban modes. The multimodal approach taken by the Translinks 21 Plan was facilitated by the development of integrated sets of passenger travel and freight shipment data for all intercity modes. The intercity modes addressed in these data sets include passenger rail, freight rail, intercity bus, auto, truck, air passenger, air cargo and waterborne freight.

For passenger travel, a multimodal travel demand model has been developed to analyze transportation improvements called for in the recommended Translinks 21 Plan. On the freight side, alternative commodity shipment forecasts for each mode were analyzed with the advice of a Freight Expert Panel made up of private sector transportation leaders and experts from throughout the state. The results of these multimodal forecasting efforts are described below.

Recommended Passenger Travel Forecasts

The following tables summarize multimodal passenger travel forecasts developed by the Department of Transportation's intercity travel demand model. This model can be used to simulate the impact of the introduction of new passenger modes, or of service improvements in existing modes. In this analysis the department used the model to compare a set of "plan forecasts" reflecting the recommendations of its Translinks 21 Plan with a set of "trend forecasts" where existing modal programs and relationships are maintained.

The recommended plan calls for completion of the Corridors 2020 highway network, implementation of passenger rail improvements including high speed rail service (125 mph) from Chicago to the Twin Cities through Milwaukee and Madison, conventional rail service (79 mph) to Green Bay, feeder bus service to the above rail services as well as intercity bus service to all communities with populations greater than 5,000. In addition, the plan enhances the state air passenger program and system.

The trend forecasts assume completion of the Corridors 2020 highway system and maintenance of current rail, intercity bus and air programs. The intercity travel demand forecasting model is supported by data derived from an extensive statewide travel preference survey. In this survey, Wisconsin travelers were asked about their mode preference under various travel time, cost and service frequency scenarios. It must be emphasized that the model predicts intercity passenger trips only -- generally those trips which cross county lines. For example, intercity auto forecasts do not include local trips and intercity bus forecasts do not include bus transit trips in urban areas. It also should be recognized that the intercity forecasts provided by the model relate only to trips within the state and to adjoining counties including the Chicago and Twin Cities metropolitan areas. For example, an air trip from Milwaukee to Kansas City is not included in the model forecasts.

In comparing trend and plan forecasts (see Table 1) the most notable change is the magnitude of ridership associated with the addition of high speed rail (HSR) service between Chicago and the Twin Cities. HSR will support 5.4 million riders in 2020. When compared to the trend forecast (see Table 2), the plan forecast also shows 801,000 fewer air trips or a 59.0% reduction from those predicted assuming current trends. This reduction is largely the result of the diversion of air passengers in the Chicago-Twin Cities corridor to high speed rail service in response to fare savings, more competitive trip times, and easy access to downtown terminals.[1]

[1] Note that the base and forecast figures for air travel only includes a subset of total trips taken. For example, in 1993 WisDOT figures show over 7.2 million departures and arrivals from Wisconsin airports.

Translinks 21 Travel Demand Forecasts

(Year 2020 Intercity Passenger Trips)

Mode	1995	2020 Trend			2020 Plan		
		Trips	Difference	% Increase	Trips	Difference	% Increase
Auto	327,832,000	405,063,000	77,231,000	23.6%	402,365,000	74,533,000	22.7%
Air	1,064,000	1,358,000	294,000	27.6%	557,000	(507,000)	-47.7%
High Speed Rail	0	0	0	0.0%	5,400,000	5,400,000	*
Conventional Rail	421,000	522,000	101,000	24.0%	400,000	(21,000)	-5.0%
Feeder Bus/Rail	0	0	0	0.0%	52,000	52,000	*
Intercity Bus	460,000	550,000	90,000	19.6%	527,000	67,000	14.6%
Total	329,777,000	407,493,000	77,716,000	23.6%	409,301,000	79,524,000	24.1%

* New Service

Table 1

The plan forecast also shows a reduction of about 2.7 million intercity auto trips when compared to the trend forecast (see Table 2). This is a result of passenger rail as well as intercity bus improvements and is less than 1% of the intercity auto trend forecast. Both currently and under the trend forecast, auto travel comprises over 99% of all intercity trips. With the implementation of the Translinks 21 Plan recommendations, auto travel maintains its dominance with 98.3% of all intercity trips in year 2020 (see Table 3). Other modes each have shares less than 1.3% of total travel.

Modal Interaction Comparison

Plan versus Trend Forecasts

(Year 2020 Intercity Passenger Trips)

Mode	Year 2020		Difference	% Change
	Trend Trips	Plan Trips		
Auto	405,063,000	402,365,000	(2,698,000)	-0.7%
Air	1,358,000	557,000	(801,000)	-59.0%
High Speed Rail	0	5,400,000	5,400,000	*
Conventional Rail	522,000	400,000	(122,000)	-23.4%
Feeder Bus/Rail	0	52,000	52,000	*
Intercity Bus	550,000	527,000	(23,000)	-4.2%
Total	407,493,000	409,301,000	1,808,000	0.4%

* New Service

Table 2

Share of
Total Intercity Passenger Travel
(Year 2020)

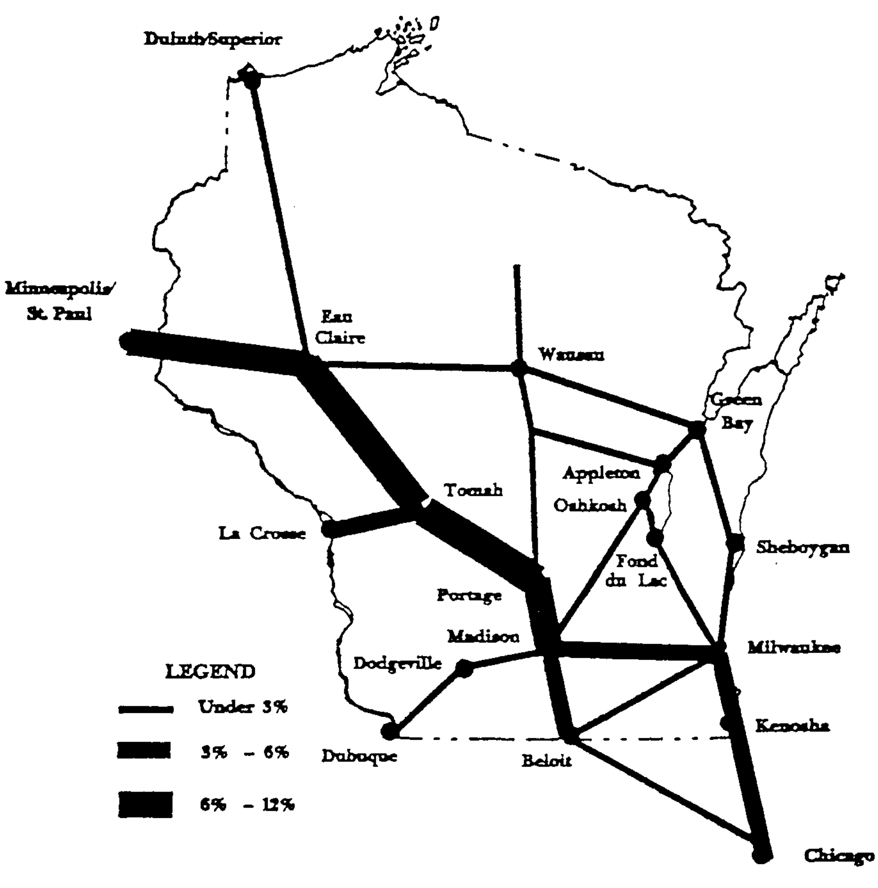
Mode	2020 Trend	2020 Plan
Auto	99.4%	98.3%
Air	0.3%	0.1%
Conventional Rail	0.0%	1.3%
Intercity Bus	0.1%	0.1%
Feeder Bus/Rail	0.0%	0.0%
High Speed Rail	0.1%	0.1%
Total	100.0%	100.0%

Table 3

Map 1 shows the results of an analysis of potential intercity *passenger* travel diversions from highways to other intercity transportation modes. These estimates are based on the department's comparison of the impact of the plan and trend forecasts on the Corridors 2020 highway network.

MAP 1

IMPACT OF RECOMMENDED PLAN ON TREND AUTO VOLUME FORECAST, 2020: Percent Reduction in Intercity Auto Volume



Forecast reductions of intercity auto traffic as a percent of intercity auto traffic and as a percent of total traffic range from 0.3% and 0.1% respectively at Whittenberg on highway 29 between Wausau and Green Bay to 12.4% and 6.5% on interstate 90/94 at Mauston between Madison and the Twin Cities. Data on these and other segments is shown in Table 4. In summary, intercity passenger transportation services -- such as conventional Amtrak trains, high speed rail, or intercity buses -- will have limited potential to significantly reduce intercity auto traffic on most highway routes.

Impact of Recommended Plan on Trend Intercity Auto Forecast, 2020

Route		Reduction in Trend	
		Intercity Auto	Total Traffic
I-90/94	Madison to Portage	6.6%	4.2%
Hwy 18/151	Madison to Dodgeville	0.5%	0.3%
I-94	Madison to Milwaukee	5.5%	4.4%
I-90/94	Portage to Tomah	12.4%	6.5%
I-94	Kenosha to Milwaukee	2.9%	1.9%
I-90	Beloit to Madison	5.1%	3.9%
Hwy 29	Wausau to Green Bay	0.3%	0.1%
Hwy 41	Fond du Lac to Milwaukee	1.3%	0.6%
Hwy 51	Portage to Wausau	2.5%	1.4%

Table 4

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) has similarly analyzed the year-2010 impact of the implementation of the SEWRPC Regional Transportation Plan on both urban auto and transit travel. The SEWRPC plan includes transit improvements resulting in an 82% increase in round-trip transit route miles, as well as highway improvements and the implementation of the regional land use plan. When compared to a year 2010 "no-build" alternative, the recommended plan results in a 4% reduction in auto travel (vehicle miles traveled) with a concurrent 17% increase in transit ridership. As is the case with alternative intercity modes above, the impact of urban transit has a measurable, although modest impact on forecast auto travel.

Continuing the analysis of travel forecasts for the remaining modes, conventional rail ridership is lower in the plan forecast when compared to the trend (see Table 2). This is a result of upgrading existing conventional rail service in the Chicago-Milwaukee corridor to high speed service as called for in the Translinks 21 Plan. Some, but not all, of this reduction is offset by new conventional rail service being provided in the Milwaukee to Green Bay corridor.

Intercity bus travel increases in absolute terms under both trend and plan forecasts (see Table 1). However, overall bus ridership is lower in the plan forecast which considers new state funding for an essential intercity bus service program for all communities with populations greater than 5,000. This is the result of a diversion of bus travelers on existing high density routes to new passenger rail services also called for in the plan. The separate bus/rail forecast (see Tables 1 & 2) is for ridership on new feeder bus service associated with planned rail service improvements.

Total passenger travel increases 24.1% in the plan forecast (see Table 1). There are about 1.8 million more trips under the plan forecast than the trend forecast (see Table 2). This is the result of new trips induced by the provision of new modes and services. The induced travel in the plan forecast is largely the result of new HSR service allowing individuals to take trips they would not have taken without its provision. New conventional rail and intercity bus services have similar effects, although not of the same magnitude.

Recommended Freight Commodity Shipment Forecasts

The intercity freight commodity shipment forecasts used in the Translinks 21 Plan are market driven in that they reflect private sector industry trends and are not based on specific public sector service improvement investments as is the case for passenger travel. The Translinks 21 Plan forecasts that over all modes, 485.3 million tons of freight will be shipped in year 2020 (see Figure 1 and Table 5). This represents a 58.4% increase over 1992. The truck mode has the largest share of total commodity shipments, with year 2020 shipments of 237.5 million tons, an increase of 49.8% over the planning period. Freight rail has the second highest share of total shipments, but a higher forecast growth rate of 72.8% between 1992 and 2020. The waterborne mode is a distant third with forecast shipments of 51.4 million tons shipped in 2020. The high-value cargo shipped by air is the smallest in tonnage, but has the highest forecast increase of 214.6%

Translinks 21 Forecast Freight Commodity Shipments, 1992-2020

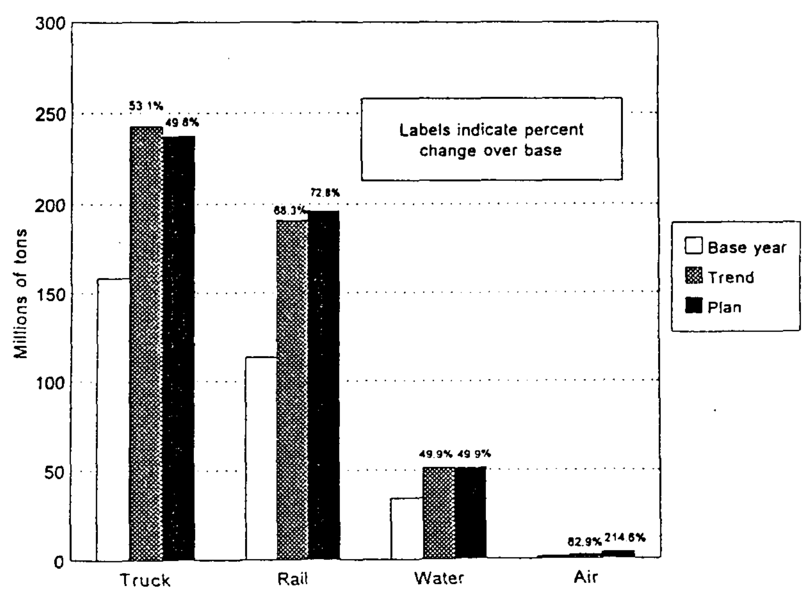


Figure 1

The department developed these forecasts through a two-step process. Trend forecasts are driven by state and county employment forecasts adjusted to account for industry productivity differences. These trend forecasts were then further analyzed and refined with the advice of the Translinks 21 Expert Panel to reflect emerging multimodal transportation issues. The resulting "plan" forecasts were then used in the ensuing development of plans for each transportation mode.

In the case of the truck and rail modes, the trend forecasts were refined to specifically address rapidly emerging truck/rail intermodal partnerships. Through these partnerships, state and national rail and trucking companies have entered into agreements to shift the linehauls of long-distance truck moves onto rail, utilizing intermodal container, trailer-on-flat-car and new "RoadRailer" technologies. As shown in Table 5, the initial trend forecast growth rates for truck and freight rail were 53.1% and 68.3% respectively.[2] They are driven by independently forecast growth rates of state industry sectors and reflect no explicit change in modal preference. The plan forecasts for truck and rail, reviewed by the Freight Expert Panel and selected for Translinks 21 planning purposes, are 49.8% and 72.8% respectively.

Translinks 21 Freight Tonnage Forecasts by Mode

(Year 2020 Tonnage)

Mode	1992	2020 Trend	% Increase	2020 Plan	% Increase
Truck	158,512,000	242,664,000	53.1%	237,515,000	49.8%
Rail	113,463,000	190,910,000	68.3%	196,059,000	72.8%
Water	34,254,000	51,363,000	49.9%	51,363,000	49.9%
Air	123,000	225,000	82.9%	387,000	214.6%
Total	306,352,000	485,162,000	58.4%	485,324,000	58.4%

Table 5

The impact of forecast truck/rail intermodal activity on forecast modal shares is shown in Table 6 where trend forecast modal shares are compared to those under the plan forecasts. The rail share of forecast shipments increases from 39.3% under the trend forecast to 40.4% with the plan forecast. The truck modal share decreases from 50.0% to 48.9% This relatively modest impact on aggregate shares is a function of the fact that the majority of freight traffic travels too short a distance to make economic use of intermodal transportation services. Similarly, on a statewide basis, the plan forecasts show that truck/rail intermodal movements will capture a relatively modest 2.1% of what had been previously truck-only moves.

[2] The greater trend growth rate for the rail mode is largely a function of significant forecast increases in coal and metallic ore shipments which generally are moved by rail, given their bulk and weight. If coal and metallic ore shipments were removed from the rail analysis, the trend forecast growth rate for rail would actually be lower than that for truck.

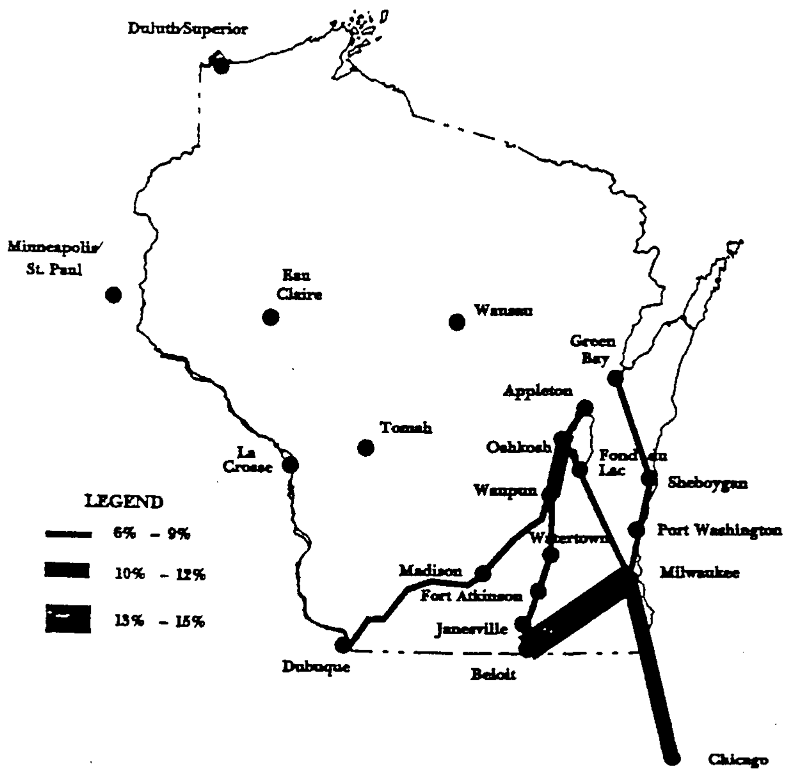
Share of Total Freight Shipments
(Year 2020)

Mode	Trend	Plan
Truck	50.0%	48.9%
Rail	39.3%	40.4%
Water	10.6%	10.6%
Air	0.0%	0.1%
Total	100.0%	100.0%

Table 6

The Translinks 21 analysis also identified those specific corridors where intermodal activity is most likely to increase through the year 2020. As shown on Map 2, the impact of forecast

IMPACT OF RECOMMENDED PLAN ON TREND TRUCK VOLUME FORECAST, 2020: Percent Reduction in Intercity Truck Volume



Map 2

intermodal trends is concentrated on highway corridors accessing Chicago area intermodal "gateway" terminals. These include corridors from Green Bay, the Fox Cities, and Milwaukee connecting to the Chicago area. In these intermodal corridors the impact on truck volumes is somewhat more significant.

Translinks 21 estimates of reductions in truck vehicle counts in these corridors as a percent of total intercity truck and total traffic volume range from 6.9% and 0.7%, respectively, on Highway 26 from Janesville to Waupun and 14.1% and 1.5% on I-43 from Beloit to Milwaukee. Table 7 provides more specific information on these and other corridors, both in terms of percent reductions in truck traffic and in terms of reductions in total traffic. It is important to recognize that on major Wisconsin highways truck counts as a percent of total traffic range from 10% to 20% Thus, while the expansion of intermodal activity may have a relatively significant impact in terms of reduced truck traffic, it will generally have a much smaller impact in terms of total traffic as is demonstrated by the figures in the table.

Impact of Recommended Plan on Trend Truck Volume Forecast, 2020

Route		Reduction in Trend	
		Intercity Truck	Total Traffic
I-43	Beloit to Milwaukee	14.1%	1.5%
I-43	Milwaukee to Green Bay	8.3%	0.9%
Hwy 41	Milwaukee to Fond Du Lac	7.4%	0.5%
Hwy 41	Fond Du Lac to Oshkosh	8.8%	0.2%
Hwy 26	Janesville to Waupun	6.9%	0.7%
Hwy 26	Waupun to Oshkosh	11.0%	1.1%
I-94	Illinois Line to Milwaukee	11.4%	1.0%

Table 7

The initial trend forecast for air cargo was similarly refined using forecasts developed in a concurrent statewide air cargo study conducted by the Department. This refined forecast was based on a more detailed analysis of emerging air cargo trends. The resulting plan forecast predicts a 214.6% increase in air cargo tonnage through 2020 (see Table 5). While this is an extremely high growth rate, air cargo maintains a share of less than 1% of total tonnage under either forecast as shown in Table 6.

The Translinks 21 plan forecast for the waterborne mode is a trend forecast of 49.9% over 1992 levels. The Expert Panel agreed that underlying industry and sectoral economic trends driving this forecast were the best indicators of the future growth of this mode. Its share of total tonnage is 10.6%, as shown in Table 6.

Summary and Conclusions

This report summarizes the intercity multimodal forecasts used in the Wisconsin Department of Transportation's Translinks 21 Transportation Plan adopted in November 1994. It discusses the Translinks 21 forecasting and analysis methodology which allows consideration of the interactions between and among both passenger and freight modes. Passenger forecasts were prepared using a newly developed intercity passenger demand forecasting model. Freight forecasts were developed using a statewide commodity flow data base and the advice of a statewide panel of freight experts.

On the passenger side, a major impact of the recommended improvements called for in the Translinks 21 Plan is the addition of 5.4 million trips on high speed rail service between Chicago, Milwaukee and Minneapolis in year 2020. A significant result of this new rail service is a forecast 59.0% reduction in air travel. Passenger improvements called for in the Translinks 21 Plan result in 2.7 million fewer forecast auto trips statewide -- less than one percent of forecast total auto travel. Total trips for all modes were forecast to increase 24.1%.

Total freight tonnage is forecast to increase 58.4% between 1992 and 2020. Truck shipments are forecast to increase 49.8%, rail 72.8%, waterborne 49.9% and air cargo 214%. Increased intermodal truck/rail activity is forecast to capture 2.1% of what previously had been truck-only moves.

As indicated above, the impact of planned passenger and freight improvements has a relatively modest impact statewide on intercity auto and truck travel. When combined, the impact of planned passenger and freight improvements on total traffic is somewhat higher on specific highway facilities. For example, the combined reduction of auto and truck travel on I-94 from Kenosha to Milwaukee is 2.82% of total traffic.

ACKNOWLEDGEMENTS

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Maps were prepared by David Beyer, Highway Planning Unit.

For More Information on this Topic, Contact:

RANDALL WADE
STATEWIDE SYSTEM PLANNING SECTION
WISCONSIN DEPARTMENT OF TRANSPORTATION
P.O. BOX 7913
MADISON, WI 53707-7913
608/266-2972

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7. PRESENTATION
FUTURE DIRECTIONS FOR FREIGHT MODELING

Harry Cohen
Cambridge Systematics, Inc.
Cambridge, Massachusetts

Information Needs: Policy Analysts

- Understanding of freight demand system and influences
- Forecasts as a platform for analyzing effects of policy changes
- Little interests in forecasts as such

Information Needs: Planners

- Growth in demand over time
- Demand forecasts for specific facilities
- Support for benefit-cost analysis

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Organization of this Presentation

- Freight-Related Information Needs of Public Agencies
- Differences between Passenger and Freight Forecasting
- On-Going Studies
- Recommendations

Identification of Information Needs (from NCHRP 8-30)

- Interviews with federal planners and policy analysts
- Survey of state DOTs
- Survey of MPOs
- Surveys of ports and airports

Specific data needs

- Truck flows
- Number of trucks and drivers
- Truck VMT by time of day
- True origins and destinations of intermodal movements

Key Issues Producing Information Needs
(from survey of State DOTs with 38 responses)

- Highway needs analysis (36)
- Truck routes and restrictions (35)
- Highway planning (35)
- Truck size and weight regulation (34)
- Planning of truck/rail intermodal facilities (35)
- Airport planning (35)
- Rail facility and access planning (31)
- Promotion of economic development (30)

Forecasting Experience

- Most state DOTs indicated they had little or no experience in freight forecasting

Survey of Metropolitan Planning Organizations (33 responses - 52 percent)

- ***Facility Planning***
  - 58 percent indicate that freight-related facilities and issues currently included in Transportation Improvement Programs
  - Examples include
    - roadway improvements for enhanced goods movement
    - port and airport landside access
    - intermodal terminal access and development
- ***ISTEA Implications***
  - Expand responsibilities of MPOs in freight and intermodal planning
  - Increased participation by freight industry representatives

Summary of Findings from Surveys and Interviews

- **Most states and MPOs have little experience in freight forecasting**
- **Range of public agency freight demand information needs is very broad**
- **Significant differences between the needs of planners and policy analysts**
- **Data availability is a critical consideration**
- **Selection of freight modes (and submodes) cannot be easily modeled**
- **Many factors affecting freight demand cannot be easily quantified**
- **More emphasis needed on identifying range of possible futures and assessing their likelihood**

Consideration of Alternative Futures

- **Less emphasis on establishing a single "most likely" forecast**
- **More emphasis on defining the range of possible futures, and assess**
- **Consider consequences of over-designing and under-designing facilities**
- **Consider consequences of over-designing and under-designing facilities**
- **Identify contingencies bearing on the relative merit of alternative**

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Differences Between Passenger and Freight Forecasting

- **Data collection (primary vs. secondary)**
- **Modeling mode and route choices**
- **Sensitivity to national and international events**
- **Sensitivity to technological advances**

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NCHRP Project 8-30 Study Objectives

- Examine the changing character and composition of freight demand
- Develop forecasting procedures

Chapters of the Proposed Guidebook

1. Introduction
2. Overview of Freight Transportation Demand
3. Demand Forecasting for Existing Facilities
4. Demand Forecasting for New Facilities
5. Policy Analysis

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Chapter 2 Overview of Freight Transportation Demand

- **The Logistics Process**
- **Key Issues**
- **Public-Sector Freight Planning**

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Factors Influencing Freight Demand

- **Factors that affect demand directly**
- **Factors that affect demand through their influence on costs and services**

Factors That Affect Demand Directly

- **The economy**
- **Industrial location patterns**
- **Globalization of business**
- **International trade agreements**
- **Just-in-time inventory practices**
- **Centralized warehousing**
- **Packaging materials**
- **Recycling**

Factors Affecting Costs and Services

- Economic regulation and deregulation
- International transportation agreements
- Intermodal operating agreements
- Single-source delivery of international LTL shipments
- Carrier-shipper alliances
- Fuel prices

Factors Affecting Costs and Services (continued)

- User charges and other taxes
- Government subsidization of carriers
- Environmental policies and restrictions
- Safety policies and restrictions
- Truck size and weight limits
- Congestion
- Technological advances
- Publicly provided infrastructure

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Chapter 3 Demand for Forecasting for Existing Facilities

- Emphasis on determining the effects of changes in economic activity and other external factors on demand for existing facilities
- Might be used to determine whether an existing facility has adequate capacity to handle projected growth
- Might also be useful for things like projecting growth in truck traffic to support decisions like pavement thicknesses
- Key feature is guidelines on how to apply economic forecasts prepared by other groups

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Chapter 4 Demand Forecasting for New Facilities

- Key feature is estimating diversion from other facilities and modes
- Basic approach involves (1) identifying potential market, (2) comparing the proposed new facility with other facilities in terms of costs, and (3) estimating the share of the market the new facility will capture
- Provides alternative procedures

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Chapter 5 Policy Analysis

- Focus is on estimating changes in demand due to policies
- Demand estimation is used primarily to support evaluation of impacts
- Usually necessary to assess how policies will affect options and costs perceived by shippers, carriers, or receivers
- This chapter will provide guidelines for assessing how policies will affect options and costs perceived by shippers, carriers, and receivers, and their responses

Appendices

- Factors Influencing Freight Demand
- Reviews of Freight Demand Forecasting Studies
- Database Descriptions
- Overview of Freight Transportation Survey Procedures and Methods
- Statistical Forecasting Techniques
- Estimating Transportation Costs
- Rail/Truck Modal Diversion
- Three Modal Diversion Models

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Quick Response Freight Manual

- **Freight Modeling and Planning by State DOTs and MPOS**
- **Patterned after NCHRP 187: Quick-Response Urban Travel Estimation Techniques and Transferable Parameters**
- **Recognize that state DOTs and MPOs have little data available**
- **Final report to be produced by February 1996**

Focus of the Quick Response Manual

- **Truck Trip Tables: Development of truck trip tables for inclusion in metropolitan area or regional traffic assignments**
- **Site Planning: Procedures and guidelines for predicting the number (and temporal distribution) of truck trips to and from specific sites and to identify routes used**
- **Growth Factors: Development of growth factors for freight demand by mode and commodity**

Scope Issue

- **What types of vehicles should be included and how should they be broken into classes**
- **Proposed solution**

  1. Commercial vehicles with 4 tires

  2. Single unit trucks with 6 or more tires

  3. Combinations

Chapter Outline for Quick Response Manual

1. Introduction
2. Factors Affecting Freight Demand
3. Data Collection
4. Simple Growth Factor Methods
5. Trip Generation
6. Trip Distribution
7. Time-of-Day Characteristics
8. Traffic Assignment
9. Calibration
10. Case Studies

Chapter 1. Introduction

- Describe purpose, scope, and content of Manual
- Help readers identify how to best use the Manual

Chapter 2. Factors Affecting Freight Demand

- Overview discussion of how demand is related to demand for goods and services, and to economic growth
- Draw heavily on NCHRP 8-30 work
- Discuss additional factors affecting demand for light-duty commercial vehicles

Chapter 3. Data Collection

- **Primary Sources**
  - Survey techniques such as tube counts, classification counts, roadside surveys
  - In-depth interviews of shippers and carriers
  - Establishment of freight advisory councils
- **Secondary Sources**
  - National data sources (TIUS, ICC)
  - State truck registration files

Chapter 4. Simple Growth Factor Methods

- **Sources of forecasts of economic growth**
  - State-funded research groups (CA, TX)
  - BLS and BEA forecasts
  - Private firms
- **Procedures for dealing with other demand-related factors**

Chapter 5. Trip Generation

- **Procedures for application at different levels of detail**
- **Per unit of building floor area**
- **Per employee (by category)**

Chapter 6. Trip Distribution

- **Procedures for application by hand or spreadsheet**
- **Transferable parameters on average truck trip lengths, trip length distributions, and friction factor distributions**
- **If possible, provide truck trip lengths both in absolute terms and relative to auto trip lengths**

Chapter 7. Time-of-Day Characteristics

- **Distribution of truck trips by time of day for range of vehicle types**
- **Striking differences in temporal distributions of single unit trucks and combinations**

Chapter 8. Traffic Assignment

- **Manual procedures for site planning applications**
- **Guidelines for how to combine truck and passenger vehicle trip tables for use with traffic assignment programs**

Chapter 9. Calibration

- Guidelines for adjusting results to conform to aggregate measures of truck activity
- Use of truck percentages and VMT data from HPMS and TIUS

Chapter 10. Case Studies

- Two case studies concerning freight data collection
- Two case studies concerning application of procedures

Air Quality Issues in Intercity Freight

Purpose: develop methods to assess emissions impacts of intercity freight operations and emissions control strategies

The study will:

- Identify emissions produced by trucks and rail intermodal service
- Evaluate implications of potential emission reduction strategies
- Suggest how to implement promising strategies.

Major emphasis:

- On simple techniques supported by case studies and examples
- Not on developing sophisticated analytic tools or defining major new data requirements

Air Quality Issues In Intercity Freight Outline of Final Report

1. Introduction
   - Purpose and use of report
   - Organization of report
2. Perspective on Freight Issues
   - Description of intercity freight industry, operating and institutional patterns
   - Problems and inefficienciesSuggested remedies
3. Freight and Emissions
   - Contributions of freight to emissions
   - Emissions characteristics of freight modes, operations
   - Relationship between freight activity and emissions
   - Strategies for mitigating freight emissions

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Air Quality Issues In Intercity Freight Outline of Final Report (continued)

4. Freight Planning and Analysis Capabilities
   - Role accorded freight in state and regional planning
   - Problems in addressing freight issues - models, data
   - Tie in to emissions analysis tools, procedures
   - Review of studies, tools, procedures in existence, on the horizon
5. Freight Emissions Methodology
   - Part I: Establish and assess background conditions
   - Part II: Identify strategies and evaluate impacts
   - Case study application of methods to real-life examples
   - Implementation guidance

Appendices:

- A1. Annotated Bibliography
- A2. Charts, graphs, tables to support methodology in 5
- A3. Case study documentation

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Scope Issue

- What types of vehicles should be included and how should they be broken into classes
- Proposed solution

  1. Commercial vehicles with 4 tires
  2. Single unit trucks with 6 or more tires
  3. Combinations

Chapter Outline for Quick Response Manual

1. Introduction
2. Factors Affecting Freight Demand
3. Data Collection
4. Simple Growth Factor Methods
5. Trip Generation
6. Trip Distribution
7. Time-of-Day Characteristics
8. Traffic Assignment
9. Calibration
10. Case Studies

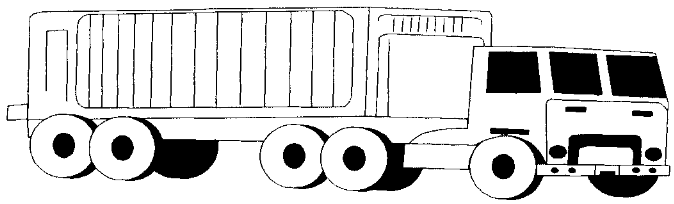
Recommendations:

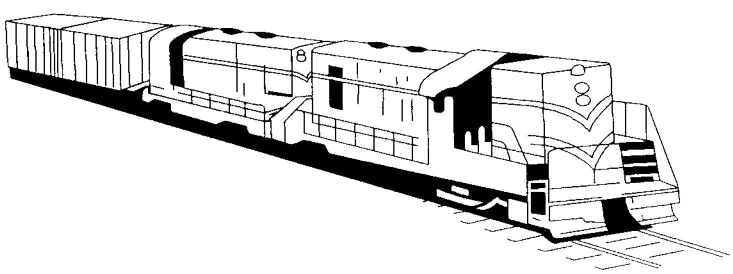
- In freight forecasting, there is a need for documents that, like the Highway Capacity Manual, provide an interface between researchers and practitioners.
- Efforts to develop improved forecasting methods should recognize the different purposes for which forecasts are needed.
- Forecasting techniques should assist planners and policy analysts in identifying alternative futures and assessing their likelihood, rather than just developing a single "most likely" forecast

Recommendations: (continued)

- Special consideration should be given to data availability in the development of freight forecasting methodologies
- For policy analysis, complicated "black box" models, which cannot be understood and reviewed by participants in the policy-making process, should be avoided.

CONFERENCE TWO DISCUSSION GROUPS





8. SUMMARY OF DISCUSSION GROUPS' RECOMMENDATIONS FOR THE FREIGHT MODELING CONFERENCE

INTRODUCTION

The majority of time during the conference was devoted to a set of three discussion groups devoted to the topics of freight models, freight data, and future research on freight issues. The leader for each group was preselected by the conference organizers. They included: Russell Capelle, CTPS; Richard Donnelly, PBDQ and Monica Francois, FHWA.

The discussion group participants began the sessions by responding to a set of questions generated by the conference sponsors. The questions can be found in Chapter 14. Each group eventually raised their own questions and discussed specific concerns of the participants. A collation and summary of these conversations are presented below under two major topics headings-

- OVERVIEW OF FREIGHT MODELS AND MODELING--This includes models used by participants, data bases, and principles to be used with models.
- RECOMMENDATIONS-- Model improvements, model needs and data improvements.

OVERVIEW OF FREIGHT MODELS AND MODELING

Models used by participants:

There were a limited number of freight models identified by conference participants. Various members from each workshop had used one or more of the models. Many conference participants have never used a freight model. The models mentioned by participants included:

- Commodity flow
- Diversion
- Tranplan
- Mobile 5
- Do nothing-produces truck trip for a region and on a corridor level basis
- Truck trends
- Commodity driven
  - -national to state to county to zip code
  - -bottom up approach
- MPO trip table-derived from 4-step model

Techniques

The participants also recognized that in place of freight models, other techniques were used to obtain information about freight flows and trends and the movement and use of freight vehicles. Only a small number of techniques were identified to supplement or in some cases take the place of modeling. From participants' comments even the alternative techniques receive limited use because of budget constraints or a lack of understanding regarding the need for the information the techniques provide. They include:

- Cordon line counts
- Urban area truck surveys
- Special studies with their own parameters inspection station-weight station
- Case studies-Mid-Ohio Regional Commissions Inland Port Infrastructure Study
- External surveys
- External-internal surveys

Data bases

The three discussion groups identified a variety of freight data bases used by agencies. The data bases can be separated into public and private (usually proprietary) sources. The list below divides the data bases into the two categories. They include:

Public Sources

CFS-Commodity Freight Survey

TIUS-truck inventory and use survey
(bureau of census)
National Truck Activity and Commodity Survey
(Bureau of Census)
Economic Activity databases-USDA

Sample Waybills (ICC)

Waterborne commerce database
(Corps of Engineers)

Export-import database (US Customs Service)

PIERS-Port import and export reporting service
(Journal of Commerce)

Private Sources

Transearch (Reebie Associates)

Freightscan (DRI-McGraw Hill)

Principles

The participants generated a list of recommended principles that should be following when trying to decide to use a freight model, using a model, refining a model or evaluating the effectiveness of a model. The principles are:

- Keep it simple
- Make models issue oriented
- Make data bases issue oriented
- Bounded uncertainty should be included in models
- Make models flexible so that new approaches (for example "just-in-time") can be incorporated
- Do not lock yourself into 4-step model for freight forecasting
- Benefit/cost should be part of freight modeling
- Don't ask the private sector if you do not intend to use their information
- Need to consider level of trust between public and private sector

RECOMMENDATIONS

Communication and Organization of Research Efforts

A number of recommendations for the Federal Highway Administration were generated by the discussion group participants. The intention of these positive comments is to help guide decisions by the FHWA as they develop their freight modeling research program and other tools. This should help MPO's and States as they begin to use models more frequently and for a broader set of applications. The first set of recommendations addresses the need for improved communications, they include:

- Improve communication across program interfaces and federal, state and local staffs
- Develop models through consortia of states (perhaps a series of model projects)
- Public-private cooperation needs to identify improvement mechanisms
- Integrate efforts of transportation planners with economic modelers

There is a need for:

- A logistics cost/trucking cost manual
- A best procedures manual for freight forecasting (ala Harvey, Skarbonis)
- FHWA should provide compendia of manuals to enhance already existing intermodal division projects

Data improvements

From the response of the group participants, one of the areas that needs a significant amount of attention is data. Not only is there a new for more data, but there is also a need for higher quality data and the data must be made more time sensitive. The list of suggested data improvements include:

- FHWA should work with ICC and the Bureau of Transportation Statistics to find out what is useful in financial and operating statistics for the trucking industry and rail waybill statistics
- Need to enhance the freight data collected from Highway Performance Management System
- For effective air quality analysis the following freight data is needed:

  type of vehicle, fuel type, operating speed, fleet mixture, volume, hot/cold starts, tampering, location and use of rail lines, acceleration and trip plans
- For analysis of congestion the following freight data is needed:

  flows and volumes, modal mix, capacity, OD (including interurban delivery), time of day, major shippers operating characteristics, intermodal facilities and characteristics, transportation network and parking characteristics, delivery stops and effect of ITS initiatives
- For pavement needs data requirements include:

  axle weight, volumes by type, vehicle type, facility upgrade priorities, pavement and environmental conditions, seasonal weight restrictions
- Types of data required for the "business" of government:

  safety, re-routing, intl crossings, overweight permits, projecting growth patterns
- The is also a need to develop software to make CFS, TIUS, and ICC waybills more useful
- Full implementation of ITS data collection

Model Needs

The groups generated a list of five specific recommendations for the improvements of freight forecasting models. They were:

- Need to build on the structure of existing models and extend their capabilities i.e. STAN portion of the EMME2 model
- Commodity and corridor specific disaggregate freight data modeling
- Emissions modeling and freight demand forecasting cross fertilization of modeling procedures, methods and practices

The participants also identified a need for number of freight parameters, including:

- Need to develop freight travel demand elasticities
- Need to create default value tables for temporal and seasonal truck trip variations
- Need to create a best practices manual for freight forecasting
- More Origin-Destination studies (including fleet mix information)
- Comprehensive list of comparative parameters for cities of similar size and economic structure

9. SUMMARY OF RECOMMENDATIONS DISCUSSION GROUP A

Rick Donnelly, Moderator/Facilitator
Parsons-Brinkerhoff, Quade & Douglas, Inc.

Group A Members

Joseph Bryan
Jorge Castillo
Arun Chaterjee
James Godfrey
Hamid Humeida
Dane Ismart
Debbie Matherly
Keith Mattson
Jason McKinley
Bahar Norris
Ken Ogden
David Owens
Randall Wade

Introduction

Our discussion group was diverse in its background and requirements for conducting urban goods modeling. This diversity facilitated a much wider range of discussion than expected--a real plus for the participants. We organized our discussions in three broad areas: the institutional context of goods movement modeling (what questions are we seeking to answer?), the various types of models in use, and the data requirements for planning and modeling purposes. We identified a wide range of issues within each area, and condensed them into a series of findings and recommendations.

The Modeling Context

The planning requirements of the ISTEA, coupled with an increasing emphasis on the operation and maintenance of transport facilities at all levels of government, establish the need for better information about freight flows and trends. The public sector participants reported an increased demand from policy-makers for more timely information about goods movement, forecasts of future activity, and their linkage to the local economy. The major findings of the group included:

1. We must broaden our perspective to encompass three major areas which are relevant in goods movement and logistics planning: infrastructure, operations and maintenance, and institutions. We have traditionally emphasized only infrastructure issues in the past (particularly in passenger travel demand forecasting), which in the context of freight planning is inadequate.

2. We must be able to state the impacts of goods movement in economic terms. This point was a recurring one throughout the session. Most policy-makers want to know how investments and policy decisions will affect the economic competitiveness of their region.

3. Goods movement is but one element of the chain of production and distribution of goods and services. Our analyses must retain that perspective if we are to understand the larger picture of economic activity (the true driver of goods movement) and to produce credible information. Many benefits and externalities of transportation decisions and options are felt outside of the transport sector, underscoring the need to consider goods movement within the larger context of the regional economy. Indeed, we often cannot make a compelling case for transport investments outside of the larger economic context. Issues such as job creation and regional competitiveness are often more relevant to decision-makers than solely improving the efficiency of the transport system.

4. We do not yet have all of the relevant parties at the table. The need to include economic planners and forecasters is obvious. We cannot produce useful models without the contributions of land use planners, major shippers, and the carriers.

The bottom line is that we must re-orient ourselves in order to carry out goods movement modeling. The comparatively isolated practice of passenger travel demand forecasting is unworkable in goods movement modeling. Moving forward means building new relationships with other disciplines, and learning far more about a part of the transport system that has typically been ignored by most public agencies.

The Modeling Opportunities

The goal of goods movement modeling is to produce relevant information for policy-makers to assist them in the prioritization of actions based upon tight resources. It was clear from the deliberations of the group that no one single type of model would fill the needs of most metropolitan areas. Three distinct types, or classes, of useful models were identified:

1. The most pressing need appeared to be for a tactical truck model, operating in tandem with the regional passenger travel demand models. Such a model would employ many of the same socioeconomic data, but would probably require modified or separate networks and produce different measures of effectiveness.

2. The tactical truck model should be linked to a strategic regional commodity flow model, with a strong econometrics basis. The strategic model must be capable of examining the linkages between sectors of the economy and impacts outside of the transport sector. While a consensus existed on the importance of a holistic view of the economy, there was lively debate on whether general equilibrium models or simulation techniques might provide better information. It was recognized the goods movement phenomenon is probably non-linear, but most felt that abstraction in a linear model was both useful and necessary. In any case, the utility of normative measures such as the value of time and the cost of uncertainty was evident.

3. A need for an intermodal facility design and operational model was articulated, although the group did not reach a conclusion on the characteristics of such a model. It was decided that such a model would focus on facility access and operations "outside of the gate," focusing upon factors within the control of MPO planners. Such actions would include traffic signal optimization, geometric design considerations, and other transportation supply aspects.

In addition, many members of the group identified the need for models capable of evaluating a wide range of the impacts of goods movement, ranging from air quality and environmental risks to safety to hazardous material transportation. While we originally envisioned this a fourth type of required model, it became apparent through discussion that these impacts must be evaluated within the context of the three model types listed above.

The utility of expert panels and reference groups were discussed by the group. It was concluded that such bodies can play an important adjunct role to the goods movement modeling process. These groups can articulate issues and problems from a unique perspective. Their measures of effectiveness and efficiency are often not the same as those of public sector transportation agencies. Such panels can also provide important insights about shipper and carriers--as industries as well as for specific major firms--which are otherwise not obtainable. They can evaluate the reasonability of forecasts and assist in the identification of emerging trends in both market dynamics and technological advancements, both of which are highly germane to the modeling process and outside of the ability of traditional static analyses to capture.

They can validate the assumptions of the analyst, and provide important feedback from the transportation consumer and provider viewpoints. In light of their potential contributions, the importance of such groups in the goods movement modeling process cannot be overstated.

Data Requirements

Based upon the modeling requirements identified earlier, the group turned its attention to the issue of data. There was widespread agreement that data on urban goods movement are not available. What data are available from secondary sources (to include the federal government) are not suitable for model development and application. While the list of data needs seemed almost endless, the imperative for the collection of basic data was apparent. The highest priority data items included:

1. Networks need to be rendered somewhat differently from the automobile networks, as carriers perceive the network differently from commuters. Different network structures for different truck size and weight classes might be required in some instances as well.

2. Origin-destination data by mode of transport and commodity group is essential for model estimation, but is rarely available. These data should be collected in such a way that temporal and trip chaining aspects can be captured.

3. It was felt that there is a substantial role that the FHWA can play in this respect, particularly with respect to knowledge sharing. Many participants mentioned that syntheses of practice and case studies from other urban areas would be invaluable in survey design. Many participants noted that their agencies cannot afford to complete extensive truck surveys. The cost per survey is often higher than for passenger surveys, making their efficient design and execution imperative. We discussed the rationale behind carrier versus establishment surveys. While accepting that the latter are more efficient, the utility of both methods was acknowledged.

4. Spatial data on economic activity and tools for exploring them are essential for model development and application. Many participants noted that we must obtain more information than simply the number of employees per traffic analysis zone. Information such as zonal density, land use and zoning, accessibility and proximity to complementary land uses, and other data are thought to be useful in the modeling process. Geographic information systems (GIS) were acknowledged as the appropriate tool for most analyses. Indeed, for some applications (such as population risk assessment in hazardous material routing) it is the only tool suitable to the task.

A variety of other data needs were identified, but without these basic data they have limited or no utility. Given that funds for the collection of primary data are limited, the value of using standard practices and definitions was readily apparent. While acknowledging that the variation in travel patterns between urban areas is probably substantial, the ability to compare results with and possibly combine comparable data would add considerable value to most local efforts.

Proprietary data sources from vendors such as DRI/McGraw-Hill and Reebie and Associates were discussed. These data have improved over time, and have been enriched with survey and economic data. When these data are updated using the 1993 Commodity Flow Survey information, they will become very cost-effective data sources. Their primary disadvantage is that the information available from such sources is at a broader geographic scale than required for urban area modeling. Nevertheless, they represent perhaps the most comprehensive secondary data source available.

By combining better information on goods movement with spatial analysis tools, we can examine the relationships between urban form and goods movement. This in turn will lead to better models of urban goods movement. The group was optimistic that the much better tools and data available today will permit us to make greater strides in urban goods modeling than have been made in past efforts.

Implementation Issues

The group concluded their activities by noting a number of priorities that transcended the three previous topic groups. Many of these issues lay the foundation for successful freight analyses and modeling:

1. There is a pressing need for training and information sharing in this area. The Travel Model Improvement Program (TMIP) was identified as a model to be emulated in this regard. In fact, the incorporation of freight modeling within the TMIP was identified as a priority worth pursuing. A renewed emphasis, on the practice within the Transportation Research Board was also identified as a priority item.

2. The standardisation of vehicle and commodity classifications and means of measuring them emerged as an important topic. With the limited resources and data available for freight modeling, maximizing the use of fused data was seen as a priority. Data must be shared for comparison purposes, to assess the degree of transferability of models (which were thought to be inherently less so than for passenger models), and possible aggregation into regional or national databases. It is unlikely that these techniques can be accomplished without standard definitions and metrics. The FHWA can play an important role here, but it must move quickly to establish a working group to develop such standards.

3. The need for more Federal emphasis on freight planning was voiced. Many MPO representatives report that the topic receives scant if any attention during Federal reviews of the planning process, and that resources to assist are generally lacking. The ISTEA mandates the improvement of the efficiency of both persons and goods movement, but the latter category is still not receiving appropriate attention.

4. Along the same lines, the need for carrier-shipper-government interaction at the highest levels was identified. The Federal government must engage in the freight planning process in order to establish its legitimacy at the regional and local level. It was noted that if Federal planners and policy-makers do not make it a priority to work closely with their transportation industry counterparts that there would be little incentive for local officials to do so.

5. While the conference brought together researchers and practitioners, several groups were still missing from the table. In particular, transportation carriers and economic modelers were absent. Their work has a large impact upon the supply of and demand for freight movement. Their input to the goods movement modeling process will be invaluable, especially at the strategic modeling level. Other groups which the group identified included land use planners and demographers, major shippers, and industry regulators.

6. Many practitioners noted the lack of suitable modeling tools for freight analyses. The STAN package is a cousin to the EMME/2 package, and can be used in tandem in regional modeling. Otherwise there seems to be very few packages available to MPO planners. The need for vendors to provide better tools or extensions of current ones was identified.

The issues discussed in this paper were identified as priority items by our group. Several other topics and issues were discussed by the group which have not been reported herein. The issues noted in this paper were thought to be of the highest research and implementation priority, and within the realm of the FHWA to provide leadership in.

10. SUMMARY OF RECOMMENDATIONS DISCUSSION GROUP B

Russell B. Capelle, Jr., Ph. D., Moderator/Facilitator
CTP Planning Staff

Group B Members

Preston Beck
Larry Castillo
Harry Cohen
Konstantinos Koutsoukos
Thomas Maze
Sherry Munion
Daniel Murray
Steve Natzke
Jeff Reding
Leigh Stamets
Samantha Taylor

Introduction

The Workshop Moderator/Facilitator started Workshop B by noting the goal of the conference as stated by Conference Organizer, Dr. Robert Czerniak of New Mexico State University: "To help FHWA to establish a research and program agenda that will last for three to seven years." The Workshop Moderator/Facilitator explained the questions that had been provided--Bob Czerniak's three-pager, "challenges" from Ken Ogden's speech, and "Practical Issues Related to Freight Models" provided by Alan Horowitz in his speech. Members reviewed and discussed selected models and databases during the first part of the first workshop day, discussed philosophical and policy points later that day, and prioritized their recommendations during the morning session the following day. The following is a summary of those prioritized recommendations, which were explained verbally to all conference attendees by the Moderator/Facilitator at the Workshop Summary Session on September 17, 1995.

Models that were discussed and reviewed included:

- Commodity flow models (e.g., Iowa's "onion model": Maze)
- Diversion models and current FHWA/FTA conversion to PC version (Natzke)
- Tranplan
- Mobile 5
- TRANSIMS

Databases that were discussed and reviewed included:

- Commodity Flow Survey of 1993 (U.S. Bureau of Census)
- Transearch (Reebie Associates' database)
- Freightscan (DRI/McGraw-Hill's database)
- Visual intermodal database (SBI project through FHWA Intermodal Div.)
- Bureau of Transportation Statistics' data sampler
- Truck Inventory and Use Survey (TIUS--U.S. Bureau of Census)
- National Truck Activity and Commodity Survey (NTACS--U.S. Bureau of Census)
- Cordon line counts and urban area truck surveys
- Economic activity databases, including Bureau of Labor Statistics' data
- U.S. Department of Agriculture data
- Bureau of Economic Analysis' forecasting in 14 sectors at the MPO level
- Inspection station/weigh station data collection efforts (states & MPOs)
- Interstate Commerce Commission Rail Waybill statistics
- U.S. Army Corps of Engineers' Waterborne Commerce database
- U.S. Customs' export/import database
- Journal of Commerce's PIERS database--Port Import and Export Reporting Service

Some case studies were mentioned and reviewed, notably the Mid-Ohio Regional Planning Commission's (MORPC) Inland Port Infrastructure Study that is often cited as a landmark freight intermodal case study.

Over-arching philosophical and policy points that were mentioned by members of the group included:

- KEEP IT SIMPLE! (Quoting an earlier remark by Dane Ismart)
- Data and models should be issue-based; there is no need to build "data cemeteries"--vast collections of never-used non-issue-based data collected just to collect data. Don't ask private sector for data [e.g., through the MPO's/state's Freight Advisory Council] if you do not intend to use it.
- Don't let the solution come before the problem; start by asking questions you want answered.
- Bounded uncertainty should be included in models. (Cohen)

- Models should remain flexible so the effects of major impactors like just-in-time, rail/truck intermodal growth, intelligent highway system (ITS) technologies, and the North American Free Trade Agreement (NAFTA) can be introduced into freight forecasting models.
- Politics can foil the best [quantitative] output/conclusions from planning models.
- Aren't we asking the same questions we asked 25 years ago?
- MORPC didn't follow the 4-step modeling process; maybe we shouldn't lock ourselves into that procedure when dealing with freight.
- How does induced demand and latent demand cause you [MPO/urban planning] to re-organize production and change demand? [Re: public/private cooperation] How do we make "them" trust "us" more, even though sometimes we're the "them" and sometimes we're the "us"?
- There's a need [in freight planning] to balance economic development considerations with social needs. Environmental regulations may change the way trips are developed/decided upon.
- Policy department decisions are often made independently of planner decisions. Cost/benefit analyses should be part of the [freight forecasting] modeling process.

Several interesting phrases were noted by Workshop members, as listed below:

"We're not at the stage of trusting freight models." (Koutsoukos)

"Induced demand *is* a sign someone has benefited." (Cohen)

"Let's call a duck a duck." (Murray)

"No data cemeteries!" (Capelle)

"What we're trying to do with congestion pricing is a self-defeating process." (Koutsoukos)

"UNDERSTANDING SHOULD PRECEDE MODELING." (Cohen)

Recommendations

Recommendations were organized into three groups, the headings for which are:

- Cooperation Produces Better Information and Data Resources
- FHWA Should Provide Compendia/Manuals to Enhance/Course-Correct Already
- Existing Intermodal Division Projects
- Freight Forecasting Model and Database Course Corrections and Fine-Tuning

Cooperation Produces Better Information and Data Resources

Cooperation produces better information and data resources--and it makes the state/MPO better able to know what questions they want answered. Two specific recommendations were as follows:

1. **Improve communication across interfaces**--interstate, interregional, interagency, interdepartmental. Develop models through consortia of states. Search out data and information beyond the borders of your bureaucratic niche--go to other departments and agencies and uncover freight and freight intermodal information already collected by others (e.g., weigh station data, public utility data on trucking companies, and so on).

2. **Public/private cooperation improvement mechanisms**--less "us" and "them," because after all we're all users of the same transportation systems and we all want to improve them. Need better cooperation between policy analysts and planners--the output of freight forecasting models used by planners, if not properly used as input into the policymaking process, is wasted output. States/MPOs need to decide on the issues that are most critical to them and collect data concisely [from or about the private sector]; build no data cemeteries and ask for only data you really need and will use.

FHWA Should Provide Compendia/Manuals to Enhance/Course-Correct Already Existing Intermodal Division Projects

Many of Dane Ismart's and the FHWA Intermodal Division's projects are nearly on target and there may be a need only for "course correcting" and enhancement of or cross-fertilization between/among certain projects. The Workshop Members recognized the following Intermodal Division projects as important to be continued to fruition: COMSIS/CSI "Quick Response" Project, SBI Intermodal Visual Database Project, Arun Chatterjee's CUFS project, and several others.

Five specific targeting suggestions or recommendations were offered by the Workshop B members:

1. **Temporal and seasonal truck trip variations** are hard for MPOs and states to summarize. It would be valuable to have an FHWA manual or compendium which culls and summarizes from MPO/state classification counts those temporal/seasonal variations--or spectra of them, default values of them, regional averages of them. Provided to states and MPOs, such a summarizing manual or compendium could provide useful input into the planning process.

2. A **<u>Logistics Cost/Trucking Cost Manual</u>** for use by states/MPOs would be very useful. Too often policies/regulations are made/passed which affect the trucking industry although policy analysts and planners having little knowledge of the *magnitude* of the impact or the *direction* of the effects and their consequences. Knowing better the costs of the industry as they apply to incident management, planning toll facilities, and the like would cause planners and policymakers to be on target more often. For example, deciding on a toll for commercial vehicles for a new toll tunnel should not be done in the absence of detailed information on how each proportion-of-a-dollar increment will affect truck traffic, trucking industry decisionmaking, latent and induced demand for other or older facilities, and the like.

3. **A travel demand elasticities summary** document for impact calculations would also be very helpful in the same way as explained under No. 2 above.

4. **Freight Advisory Councils** have been formed by states and MPOs around the country and many are making fantastic progress--eliciting information and indeed data from the private sector from surveys or cooperative sharing agreements, isolating the most important private-sector-identified issues which planners/policymakers need to address, and finding procedures for cooperation which can be used elsewhere. It is not productive to have FACs doing things in isolation. Why not have an **FHWA Intermodal Division guidebook which summarizes practices, procedures**, cooperative mechanisms, survey results, information, issue identification, and databases from FACs around the country--the better to follow Alan Horowitz's suggestion of developing "parameters" that are "transferable . . . across cities"?

5. **A <u>Best Procedures/Practices Manual for Freight Forecasting</u>**--in the same vein as the above suggestion, FHWA Intermodal Division could summarize what states/MPOs "A," "B," "C," and so on are doing, thus establishing parameters usable elsewhere. What procedures in freight planning are used in Wisconsin and how do they compare/contrast with New Jersey's? With California's? What can we learn from summarizing practices and procedures from the various laboratories--the state DOTs and MPOs across the country? This summary manual would address freight forecasting/urban goods modeling *procedures and practices which could be used in other states/MPOs,* rather than policies, philosophies, scenarios, or policy-outcome strategies.

Freight Forecasting Model and Database Course Corrections and Fine-Tuning--*Models*

Three specific model-related recommendations came out of Workshop B's deliberations:

1. **Commodity/corridor-specific disaggregate freight data modeling is needed.** The four-step process and gravity model so convenient in passenger travel demand forecasting may not be appropriate, without modification, for freight forecasting. Different freight modes have different trip-making behavior depending on what is being carried (commodity) through which corridor. For example, general freight less-than-truckload (LTL) carriers behave differently along the I-80 east-west corridor than do primarily local-delivery petroleum tank trucks. And trip-making behavior through the I-80 is different than that through the I-75 corridor--or on an urban area's major arteries "X" and "Y." Another example: The potential for diversion of containers/trailers from highway to rail is certainly greater through a landbridge West-Coast-Chicago-East-Coast route than it is on routes out of the Powder River Basin where unit trains of coal predominate or in the wheat-belt states where grain traffic predominates.

2. **Emissions modeling/freight demand forecasting cross-fertilization of modeling procedures, methods, and practices** should be possible. A long history of vehicle-miles-traveled modeling, commercial freight emissions modeling, and other freight-specific procedures are well known by environmental/emissions/air quality planners. Such methods, models, and data could be borrowed by freight forecasters where possible. (See also No. 1 above.)

3. **Parameters across cities**--Alan Horowitz highlighted the need for transferable parameters across cities. What we are really asking for is an ITE Trip Generation Manual-like book done by FHWA's Intermodal Division. In the book would be *average truck trip generation rates* usable by other states/MPOs--derived from and summarized from recent MPO/state truck surveys and truck trip studies. This suggestion/recommendation is a fine-tuning recommendation for cross-fertilization and enhancement of *already ongoing Intermodal Division projects mentioned above*--Chatterjee's CUFS, COMSIS/CSI's "Quick Response," SBI Intermodal Visual [county-to-county] Database, and others. Workshop B did not mean to suggest that FHWA Intermodal Division is not on track with current projects, but merely that we are all looking for that off-the-shelf, back-of-the-envelope, here's-a-rate-you-can-use "fix." Some synergistic work among existing projects, flavored with a few new gap-filling projects, could provide that "fix."

Freight Forecasting Model and Database Course Corrections and Fine-Tuning--*Data*

Three specific data/database suggestions were made:

1. **Software could be developed to make CFS/TIUS/ICC Waybill more usable.** The Commodity Flow Survey of 1993 may provide "control values" or cordon-line-like totals against which to bounce truck trip numbers for individual MPOs. The Truck Inventory and Use Survey has many possibilities for providing frequency distribution data that can enhance MPO regional modeling efforts. Rail data available in the detailed datatape for the Interstate Commerce Commission's rail waybill statistics can be valuable for MPO and state intermodal planning. Although the numbers would be different for different states and MPOs, it seems very possible that under FHWA Intermodal Division funding *software could be developed* to extract the *same type of number* for different places. For example, software designed to extract just the number of annual vehicle miles traveled by tank truck carriers that operate between 49 and 52 weeks a year in only local trips (50 miles or less) from the 1992 TIUS microdata tape would generate different results for Boston and for Reno. However, the same software could be used by Boston and Reno for extraction of the numbers need. Such software would not only help additional users, but would have the value-added effect of making already existing and funded federal databases more widely used. Better using data we have already collected should be a goal for us all.

2. **Data collected by the Interstate Commerce Commission** may have many uses at the state and MPO levels. FHWA's Intermodal Division should work with the Bureau of Transportation Statistics, Office of the Secretary, and other agency modules to retain what is usable in the financial and operating statistics for the trucking industry and the rail waybill statistics, to mention just two specific databases. For example, the characteristics of trucking segments that can be summarized and calculated form the trucking company annual reports to the ICC builds the understanding of the trucking industry which is urgently needed at the MPO and state levels. ("Understanding should precede modeling." [Cohen])

3. **Enhanced classification data collection from Highway Performance Monitoring System** may make the output more usable to other groups in state DOTS--other than those whose task is now HPMS-data-related--and to MPO planners. For example, if commercial vehicle data were collected in slightly more detailed classification schemes to merge better with the classification data used in MPO regional modeling for calibration purposes, this would be *value added from an already existing data collection program.* We are not suggesting instituting new data collection, merely supporting the overall goal we all have at the Albuquerque conference--recycle data already collected for other purposes.

Conclusion

Workshop B engaged in lively discussions and arrived at the valuable recommendations offered above to fine-tune FHWA Intermodal Division's research agenda for the next three to seven years. We offer these for consideration, discussion, and, hopefully, as ***action items*** which will result in improved freight demand forecasting practices and procedures at the state and MPO levels.

11. SUMMARY OF RECOMMENDATIONS DISCUSSION GROUP C

Monica I. Francois, Moderator/Facilitator
Federal Highway Administration

Group C Members

George Cepess	Hani Mahmassane
Teodor Crainic	Chritopher Primus
Kim Fisher	Mike Sclar
Alan Horowitz	LaRon Smith
Robert Koehler	Matthew Thornton
Eric Irelan	Nancy Whalen

Introduction

Section I is a summary of discussions surrounding four model types, types with which group members was most familiar. In Section II, discussions surrounding the need for freight forecasting are summarized. Finally, in Section III, recommendations and priorities for FHWA research are summarized.

SECTION I

Early in the break out session, discussions centered around which freight models have been used or developed by group members. Four model types were identified, and placed into the general categories of:

- Do Nothing
- Truck Trends
- Commodity Driven
- MPO Travel Demand Model or Trip Table Based

Do Nothing Model

This approach produces truck trips for a region, and on a corridor level basis. For project level study, accompanying special studies are usually done. Confidence in model outputs is often limited, due to uncertainty regarding the inputs (generally households, population, retail employment, and total employment). Outputs are validated to ground counts. External surveys and external-internal interviews are also used.

The "do nothing" approach should be treated as one tool among many, to be accompanied by other analyses and information during the decision-making process. Also, this approach is not very effective in conducting transportation-related air quality analysis.

Truck Trends

With this approach, vehicle classification sites are assigned and expanded according to functional class, and forecasts of vehicle trips are generated as needed by truck type. Information is yielded that federal funding regulations and freeway design standards require. Data collection requirements associated with this method are well understood. Truck trends sometimes require special studies and special generator analysis as supplements for certain applications.

There is generally no role provided for public/private involvement. Advanced technologies and classification tools could improve truck trend analysis, as could better techniques for expanding counts out to a full universe. Generally, truck trends are not sensitive to policy questions such as special generators, NAFTA, or land use.

An example of the Crescent project, where traffic is tracked from Mexico to British Columbia, was cited as an example where advanced technologies have shown potential in monitoring truck movements.

Commodity Driven

Two levels of commodity driven models were discussed: (1) national-to-state-to-county-to-zip code and (2) a bottom up approach. Merging national and local commodity models and application is likely to be difficult. Applications of this approach include exploring policies, infrastructure investment, carrier problems, vehicle weights, air quality, and roadway impacts. Forecasts produce detailed commodity and vehicle trip outputs.

Validation is difficult, and problems exist with data availability and data costs. Opportunities for improvement lie in better collected information from private operations. Counting inaccuracies also arise in distinguishing between recreation and freight vehicles. Documentation of commodity-driven models varies.

The major barriers to widespread implementation of this approach center around its data intensiveness; the model is dependent on many factors outside the control of transportation planners, a fact exacerbated by time and training constraints. Moreover, behavior of both the shippers and the carriers must be captured to understand logistics decisions and produce forecasts.

The major benefit to commodity-driven models is their usefulness for multimodal analysis at the state level, and for assessments of major intermodal facilities. This approach is also important in cases where infrastructure investments and the rationales behind them are seen as critical.

MPO Trip Table

Freight models are often incorporated into a region's four-step travel demand model, generally based on origin and destination surveys conducted in the 1960's or 1970's. Some of the group members' approaches to handling trucks in the four-step process include: in trip generation, breaking out taxis; in trip distribution, using gravity, logit or fratar methods -- though fratar is unresponsive to model structure changes; in traffic assignment, using either separate truck trip assignments or summary tables.

Overall, this freight forecasting approach is one part of the forecasting routine in use for some 25 years. Written descriptions of a model's freight components are likely to be a page or less in a model's documentation.

Inputs can include households, employment, population, employment by categories, residential or industrial acreage. Very little validation is done of truck forecasts, and tests for reasonableness are very loose. Confidence in the forecasts is low; group members have experienced no real complaints, however, in the many years they have used this method. Validity of the freight portion of the model has been cloaked by the "smoke screen" provided by the rest of the model. Improvements to the approach could be made by upgrading data inputs, using better calibration technologies, reviewing and revamping the models, and more peer reviews and expert input from stakeholders.

This approach does not address detailed policy issues, though it does address some of the more broad issues faced. Questions arise concerning how stable truck traffic is over time, in terms of percentage of trucks, mix of trucks and location of truck trip ends. To date policy makers in many regions have not really focused on the freight question. Also, as yet -- many non-attainment areas have not had air quality challenges posed to their models and freight forecasting approach.

SECTION II

Need for Freight and Truck Models

The group discussed several reasons for which freight forecasting models are needed. These included air quality analysis, dealing with congestion related problems, planning for pavements, and supporting the business of government.

In the group's discussions, it became clear that <u>each of the four model types reviewed in Section I (above) is appropriate for different forecasting needs, and that each has an important function worth maintaining</u>. For example, the Truck Trends approach is good for pavement planning but may not be sufficient for air quality planning, while the Commodity-Driven model is good for air quality, but is usually more than is needed for pavement planning. Thus, the level of complexity involved in an application should trigger the selection of the appropriate method. Quite often, the Do Nothing approach may be adequate.

Application-Based Information Needs

If **air quality** is to be addressed effectively, freight traffic needs to play a significant role in the analysis. The following freight-related information is needed for effective air quality analysis: type of vehicle, fuel type, operating speed, fleet mixture (including age of vehicles, maintenance, etc.), volume, hot/cold starts, tampering, location and use of rail lines, acceleration, and trip plans.

Freight models are also needed to manage and deal with **congestion related problems**, such as hazardous material movement, operations, volume in excess of capacity, and incidents. The following types of freight information are needed to investigate freight's relationship with congestion: flows and volumes, modal mix, capacity, origin and destination (including interurban service and delivery), time of day, major shippers' operating characteristics, intermodal facilities and characteristics, transportation network and parking characteristics, delivery stops, and the effect of ITS initiatives.

To address **pavement needs** over time, information on current and future freight movements are again very important. Data needs to handle this issue include: axle weight, volumes by type, vehicle type, facility upgrade priorities, pavement and environmental conditions, and information on changes to seasonal weight restrictions.

Freight traffic and forecasts were also discussed in terms of the substantial role they play in the **business of government**. The types of issues that governments must address in this area include: safety, re-routing, international crossings, overweight permitting, regulations, supporting ISTEA's management systems, assessing and realizing economic development potential, identifying freight movement needs, analyzing local projects, justifying projects, and projecting growth patterns.

SECTION III

Next Steps and Recommendations

Several suggestions were made with regard to research or tools that would improve the state of freight forecasting. Among these were:

- More origin and destination surveys, including fleet mix information and other data needed to fuel air quality analysis and commodity models
- Full implementation of ITS data collection (including weight, type of vehicle fleet, operating characteristics, O&D information, commodity type)
- Research on how best to collect data from shippers, carriers, and intermodal facility operators
- Industry guidelines to determine flow through an area
- Truck trip generation rates, and suggestions to ITE that they break out trips by truck or car
- National effort to increase information flow and reporting by carriers, ex. Way bills
- Case studies considering the impact of freight in developing review process techniques, benefits

- Research into forecasting truck fleet changes
- Research on the transferability of truck data from one geographic area to another
- Flow of information between agencies
- An ABC's type manual on understanding commodity flow
- A format for data collection which supports freight forecasting, ex. using SIC codes, zip codes as geographic level
- With guidance from freight professionals, a standard framework for different types of freight model development, ex. DOS or ANSI standards
- Research on the interplay in the "economy-commodity-transportation" activity chain
- Guidelines for truck classification categories which are multi-purpose
- Maintained funding for SHARP long term pavement performance equipment and data

Priorities for Action

The group members were given three votes and asked to select their priorities from the recommendations made above. During the voting process, some recommendations were combined and refocused. The results of the priority setting exercise are included below. These suggestions are posed to FHWA as they assemble their freight forecasting research program.

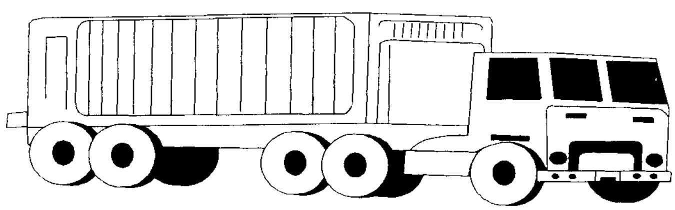
<u>Top Priorities</u>

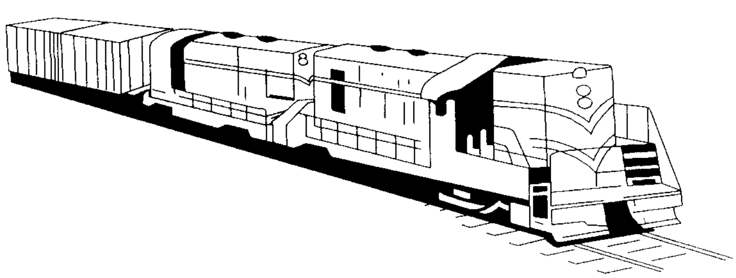
- "Give dollars and assistance and not mandates"
- Funding for origin and destination surveys
- Research on forecasting the economic variables key to commodities and transportation, ex. future multimodal fleet mix
- Guidelines for collecting logistics information from shippers, carriers and manufacturers, information which can also feed intermodal facility models

<u>Additional Priorities</u>

- Data collection guidelines for making data multipurpose and useful for different applications
- FHWA's help in establishing a standard operating framework for different types of freight model development, to encourage more compatible model platforms
- An ABC's manual of commodity flow information
- Maintaining funding for long term pavement performance equipment and data

CONFERENCE TWO
INVITED PAPERS





12. INVITED PAPER
URBAN GOODS MOVEMENT PLANNING IN USA: A HISTORICAL PERSPECTIVE

Arun Chatterjee, Professor
Department of Civil & Environmental Engineering
The University of Tennessee
Knoxville, Tennesse

Background

Urban transportation planning based on a methodical process, which included the use of land use and travel forecasting models, began in the United States during the middle 1950's. A few pioneering studies were performed during that period in a few large metropolitan areas including Detroit and Chicago. In 1962, the Federal-Aid Highway Act required for the first time that a comprehensive, continuing, and cooperative transportation planning process be performed at every urbanized area of more than 50,000 population in order to qualify for receiving federal funding for highway projects. The scope of this comprehensive planning process included the movement of both persons and goods.

Following the 1962 landmark legislation, the then Bureau of Public Roads developed detailed guidelines for carrying out urban transportation planning, and it was a data intensive long-range process. There was a strong role for travel demand modeling. However, not much information and guidance were included for urban goods movement (UGM) planning. Freight terminal and transfer facilities were mentioned as one of the basic elements, and origin-destination (O-D) surveys included truck movements.

Commonly Used Approach

Soon after the 1962 legislation, which required long-range transportation planning, there was a boom in transportation studies in the United States. These studies gathered O-D data for commercial vehicles, which include trucks. Both internal and external truck trip movements were captured by these O-D surveys. In most cases no data were collected on commodity flows or freight shipment. Truck trips were treated separately from person and automobile trips in the trip generation and trip distribution stages of the stepwise travel modeling process. However, at the traffic assignment stage, truck trips were combined with automobile trips, and total vehicle trips were assigned on highway networks. There were only a few cases where truck trips were assigned on the network separately from automobile trips, but these were exceptional cases.

Most of the transportation studies led to the development of highway plans for urban areas based on total traffic volumes, which represented predominantly automobile traffic. An implicit assumption of this approach was that roadway improvements for passenger vehicles would satisfy the needs of freight vehicles. This assumption actually is valid for a large portion of the road network. However, in most urban areas there are specific areas with a large concentration of truck trips needing special attention and strategies, and these locations could not be identified easily from traffic assignment results when truck trips are combined with other vehicular trips.

Special Interest Areas in UGM during 1970s and 1980s

As explained in the preceding section, during the early years of urban transportation studies there was an effort to collect data on truck movements although eventually truck movements were not examined separately. In a few cases such as in Chicago, a special effort was also made to study freight terminals and related issues. However, once the first round of urban transportation studies was completed the data collection and modeling process went through certain changes. For updating previous transportation plans, new studies were undertaken using a somewhat different approach. Comprehensive O-D surveys became rare, and old travel models were recalibrated with small sample home-interview surveys primarily to verify trip generation models. New truck travel surveys were seldom undertaken except in selected areas such as New York metropolitan area and Chicago. In the majority of cases of these updated studies truck trips were ignored. However, during the early 1970's interest in special areas of UGM planning emerged in different ways, and a few examples of these topics/studies are presented below:

Garment Center Study. A few studies focusing on certain special aspects of UGM were funded by the then Urban Mass Transportation Administration (UMTA) during the early 1970's. Charles Hedges of UMTA played a key role at that time in promoting the case for UGM planning. An interesting study during this period examined the freight delivery problems of the Garment Center of New York City (1). This study led to a ban on automobile traffic during the mid-day period on weekdays along a few block of streets.

Freight Consolidation Terminals. During this time period a few research studies examined different concepts related to freight consolidation terminals in urban areas, which were considered to be a means to reduce truck trips in congested areas such as the central business district (CBD) (2). According to one specific concept of a consolidation terminal different freight companies will use common delivery vehicles for serving a specific area/zone of an urban area instead of each company sending its own vehicles to serve the area/zone. Except for a few special cases freight consolidation terminals generally were not considered seriously due to several reasons, which include institutional difficulties of implementation.

Freight Demand Modeling

It was discussed earlier that the travel demand modeling procedure incorporated in the urban transportation planning process included freight travel in terms of vehicle trips, i.e., truck trips, which were combined with automobile trips to obtain total vehicle trips. During early 1970's a group of travel demand modelers showed interest in alternative procedures and approaches for freight demand modeling. A conference was held in December 1970, in Airlie House (Virginia), where a small group of researches examined different aspects of urban commodity flow and modeling (3). During this time period several papers were published including one by Meyburg and Stopher (4). A book by Watson also was published at this time (5). Some of the issues related to freight demand modeling, that were identified are listed below:

1. What is the appropriate "unit" for measuring freight demand -- a vehicle or a shipment/consignment? A few modelers used commodity measured in tons as the "unit" of demand.
2. How to describe a shipment -- commodity class, size, weight, etc.?
3. How to collect shipment origin and destination data? This involved the issue of confidentiality and costs.
4. What policies/strategies can be tested with the freight demand model?
5. Can business practices of private freight companies be influenced by public sector planning? Is mode choice relevant for UGM planning? Is 'carrier choice' more relevant for UGM than 'mode choice'?
6. Can the complex decision making process involving slippers, receivers, and carriers be captured by traditional travel demand models?

Conference Series on UGM

A series of five conferences titled Goods Transportation in Urban Areas was sponsored by the Engineering Foundation during the period between 1973 and 1988. These were organized by late Gordon P. Fisher of Cornell University, and were held in South Berwick, Maine; Santa Barbara, California; Sea Island, Georgia; Easton, Maryland; and Santa Barbara, California. The proceedings of the first four conference were published by the U.S. Department of Transportation, and that of the fifth conference was published by the American Society of Civil Engineers (6). These conferences covered a variety of topics related to urban freight transportation.

TSM and Urban Goods Movement

In 1975 UMTA and Federal Highway Administration (FHWA) issued a set of joint regulations that emphasized Transportation Systems Management (TSM), which strongly recommended the application of low cost strategies to utilize existing transportation facilities and resources more efficiently. This approach was also reflected in UGM planning. At this time, The University of Tennessee, Knoxville performed a study sponsored by FHWA. The study identified a variety of low cost strategies to improve the efficiency of urban goods movement (7). Several other research studies at this time examined various issues involving curbside loading zones, and off-street loading docks for trucks (8, 9, 10). Following The University of Tennessee study, FHWA funded another effort to develop a handbook/manual for UGM planning. This study was developed by the Texas Transportation Institute. (11). An individual who made a significant contribution to the UGM state-of-the-art during this time period is late Richard A. Stately, who published articles on a variety of topics including freight terminals and different types of freight vehicles (12, 13). A landmark publication during this period is a book on urban goods movement authored by K.W. Ogden, which covers all aspects of UGM planning in a thorough manner (14).

The common aspects of the above mentioned studies and publication/reports emphasized the following:

1. Most of the UGM problems involve truck movements.
2. Engineers and planners of public agencies should consult the persons directly involved with truck operation such as the managers of trucking companies to identify the problems and opportunities related to UGM in a community. Representatives of the freight community must be included in the planning process.
3. An efficient freight system is essential for the economic viability of a community. Therefore, transportation engineers and planners should try to accommodate and facilitate UGM instead of imposing restrictions and barriers.
4. A variety of traffic operational and land use planning oriented strategies can be used for accommodating the needs of freight transportation providers, and these include the following:
    1. Planning Oriented:
        a. Off-street loading space - include appropriate requirements in the zoning ordinance.
        b. Freight terminal location and transportation park - use land use planning tools to identify good locations for freight terminals and provide adequate access for large trucks (15).

2. Traffic Engineering Oriented:

    a. Curbside loading zone and turn-outs.

    b. Obstacle free truck routes

    c. Intersection/interchange design to accommodate large trucks

ISTEA and New Initiative

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 has created a new interest in freight planning at both statewide and urban levels. One of the 15 factors to be considered by the Metropolitan Planning Organizations (MPO) in developing transportation plans and programs refers to methods for enhancing the efficient movement of freight. In addition to this requirement for metropolitan planning, the Intermodal Management System (IMS) studies also include a component that examine freight transportation issues and opportunities in urban areas. Most of the intermodal freight facilities such as ports, rail-truck intermodal yards, and airports are located in urban areas. ISTEA already has had a positive impact of urban freight planning and FHWA is providing strong leadership in promoting the case of freight transportation planning. Hopefully, the interest in UGM planning will continue and contribute to increased efficiency of the urban freight system.

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13. INVITED PAPER
AN IOWA APPROACH TO STATEWIDE FREIGHT DEMAND MODELS OR THE ONION APPROACH TO FREIGHT DEMAND FORECASTING

T.h. Maze
Professor of Civil and Construction Engineering
Director, Iowa Transportation Center
Iowa State University
Ames, Iowa

Ayman G. Smadi
Research Associate
Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

Reginald Souleyrette
Assistant Professor of Civil and Construction Engineering
Associate Director, Iowa Transportation Center
Iowa State University
Ames, Iowa

Introduction

Over the last several years, individuals who have attempted to model freight transportation demand have done so by attempting to transfer urban travel demand modeling techniques to freight transportation demand forecasting. For example, once in the 1970s and again in the 1980s, the National Cooperative Highway Research Program invested heavily in the development of manuals to assist statewide freight planners in the development of freight transportation demand models.[1,2,3] Much of the guidance was fundamentally based on the principals used for urban travel demand modeling.

Applying the urban travel demand paradigm to freight transportation assumes that urban trips and goods movements are similarly motivated, that decision makers in each system operate under a common decision-making process, and that the objectives for modeling freight transportation and urban travel are similar. We believe that none of these assumptions are true and support our argument in the following pages. Further, we believe that a layered approach, like an onion, provides a better paradigm for development of freight transportation demand models than the one used in urban travel demand modeling.

Our approach to freight transportation modeling is built using layers, with each layer representing goods moved by a separate industry or economic sector. This layered approach is illustrated in Figure 1. Because firms with similar attributes that ship similar goods are likely to have similar transportation requirements, freight transportation demand lends itself to this approach. After developing the layers for each economic sector, these layers can be overlaid to cumulatively result in an entire model of a state's or a region's freight transportation flow.

The Four Step Urban Travel Demand Modeling Approach

Urban travel demand modeling evolved in the 1960s into a four-step process. Before the process can begin, a network of transportation facilities and services must be generated and the urban area must be divided into small zones where each zone has nearly homogenous land-use characteristics (traffic analysis zones). The four steps in the urban travel demand process are not always applied in exactly the same order. Generally the first step involves the generation of trips. Generation includes the estimation of all trips produced (trips of all purposes and by all modes) from traffic analysis zones and the estimation of the quantity of trips attracted by traffic analysis zones. In the next steps, the trip productions and attractions are linked through a trip distribution model. This step results in an estimate of the volume of all trips between origins and destinations by all modes. The next step splits trips between transportation modes (usually automobile and transit) based on the level of service of each mode, attributes related to the trip, and socioeconomic factors of the traveler. Lastly, trips are assigned to a specific route.

The primary purpose of this process is to be able to estimate the amount of passenger and automobile traffic which will be loaded on the links of the transportation system at the same time of day. In other words, the models are built to be able to estimate congestion by simultaneously considering trips of all purposes and from all origins and destinations in the urban area and assigning them to a specific segment of the transportation infrastructure.

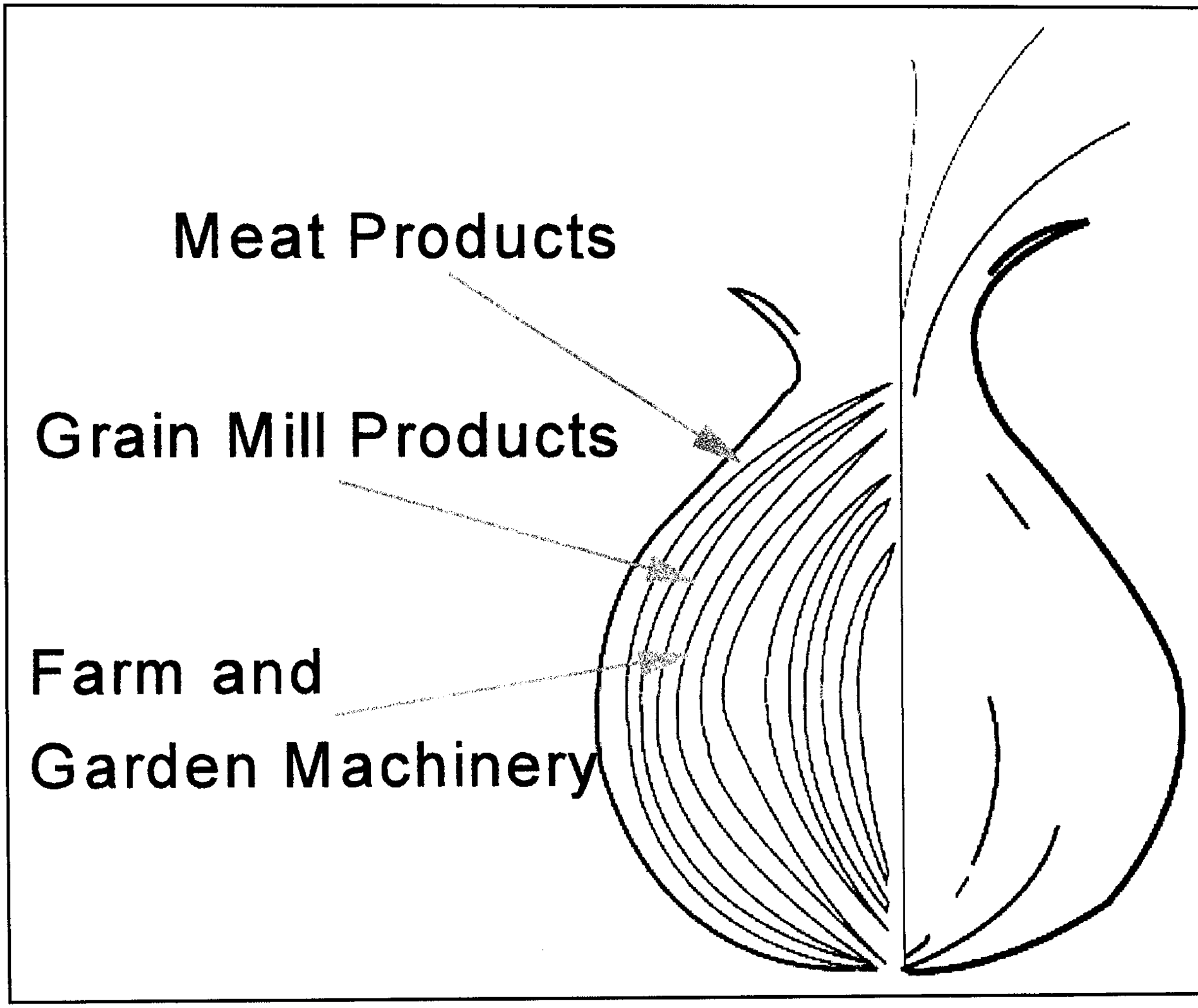


Figure 1 The Onion Model and Its Layers

The urban transportation planning process and travel demand models support the analysis of issues ranging from mobile source air pollution to equity of transportation services between population groups. However, the primary use of urban travel demand models is to determine how modifications to the transportation system will impact traffic congestion and travel times. The ability to accurately estimate the number of trips of all types which must travel over the same transportation infrastructure at the same time is a fundamental objective of urban travel demand models. Thus, the capability which most fundamentally defines the robustness of urban modeling applications is their ability to accurately estimate traffic or passenger volumes during peak use periods.

Freight Transportation Demand Modeling

There are two fundamental issues which differentiate freight transportation demand modeling from urban travel demand modeling. First, urban travel demand models forecast the transportation services demanded by people, and it is assumed that travel decisions can be modeled in a signal construct over the entire population of travelers. In freight transportation, however, a wide variety of goods are moved with heterogeneous attributes and transportation requirements. Therefore assuming that all commodities may be considered simultaneously in one demand model is probably unrealistic. The second issue involves the intended use of the model. Models used to estimate urban travel demand must be able to accurately estimate congestion to allow planners and engineers to accurately size urban facilities. Conversely, in most cases, congestion is not a key issue for intercity freight transportation. Because congestion is not a critical issue, there is no need to simultaneously load all traffic on modeled infrastructure links simultaneously. Together, these two issues present compelling reasons for segmenting freight traffic by commodity or economic sector. Each segment becomes a layer, and together all the layers (or the majority of the layers) provide an aggregate estimate of all freight traffic.

Below we have identified five steps for use when developing statewide or region wide freight demand modeling tools.

1. Develop realistic goals and objectives for the analysis tools being developed and prioritize the key issues. The more specific the objectives, the more focused the development of the analysis tool should be. For example, most urban travel demand models have the objective of being able to accurately forecast the number of automobiles or passengers traveling along each segment of transportation infrastructure during the same period of the day to resolve issues related to capacity and congestion. Outside of terminal areas, very seldom will issues of capacity and congestion become primary motivating goals for developing statewide or regional freight demand models. More commonly, goals for the analysis will focus on economic development issues and understanding the impact on the transportation infrastructure of growth or recession for a particular industry. Therefore, models designed to support freight transportation demand as it relates to economic activity of the prevalent industries in a region may be more desirable and appropriate than those designed to deal with issues related to capacity and congestion.

2. Decompose the development of the analysis tools into meaningful and manageable steps (layers). Freight transportation decisions are made by shippers and carriers where the decisions

are dependent on a myriad of market conditions and commodity attributes. Attempting to develop analysis tools which simultaneously and accurately predict freight volumes for all commodities are probably unrealistic. If the development of analysis tools focuses incrementally on shippers in one industry (economic sector) at a time, tools can be developed to address planning issues of a realistic scope. This is the architecture of the onion, building the model one layer at a time.

3. Identify the economic sectors and subsectors which generate the most freight traffic with the geographic region. By developing freight transportation planning tools incrementally, with one group of similar commodities at a time, the analysis should focus on predominant economic sectors first. In Iowa, for example, freight traffic of manufactured goods was found to be highly concentrated into a few economic sectors and even further concentrated by location (e.g., activities for specific industry were generally concentrated at one or a few locations in the state).

4. Identify the data requirements to support the development of freight transportation analysis tools. When identifying data requirements it is important to recognize there are likely to be limited data, and, therefore, it is important to narrowly focus data requirements while ensuring that freight transportation planning goals and objectives may be supported.

5. In contrast to the previous step, this step involves identifying the availability of data and designing instruments for collection of unavailable data. Data needed to support the freight transportation demand modeling process are likely to be derived from a wide variety of sources aggregated over different geographical coverages and over different time periods. The difficulty is in seeking out sources of information and being able to disaggregate or aggregate them into a form which is meaningful for analysis.

Building the Freight Transportation Model

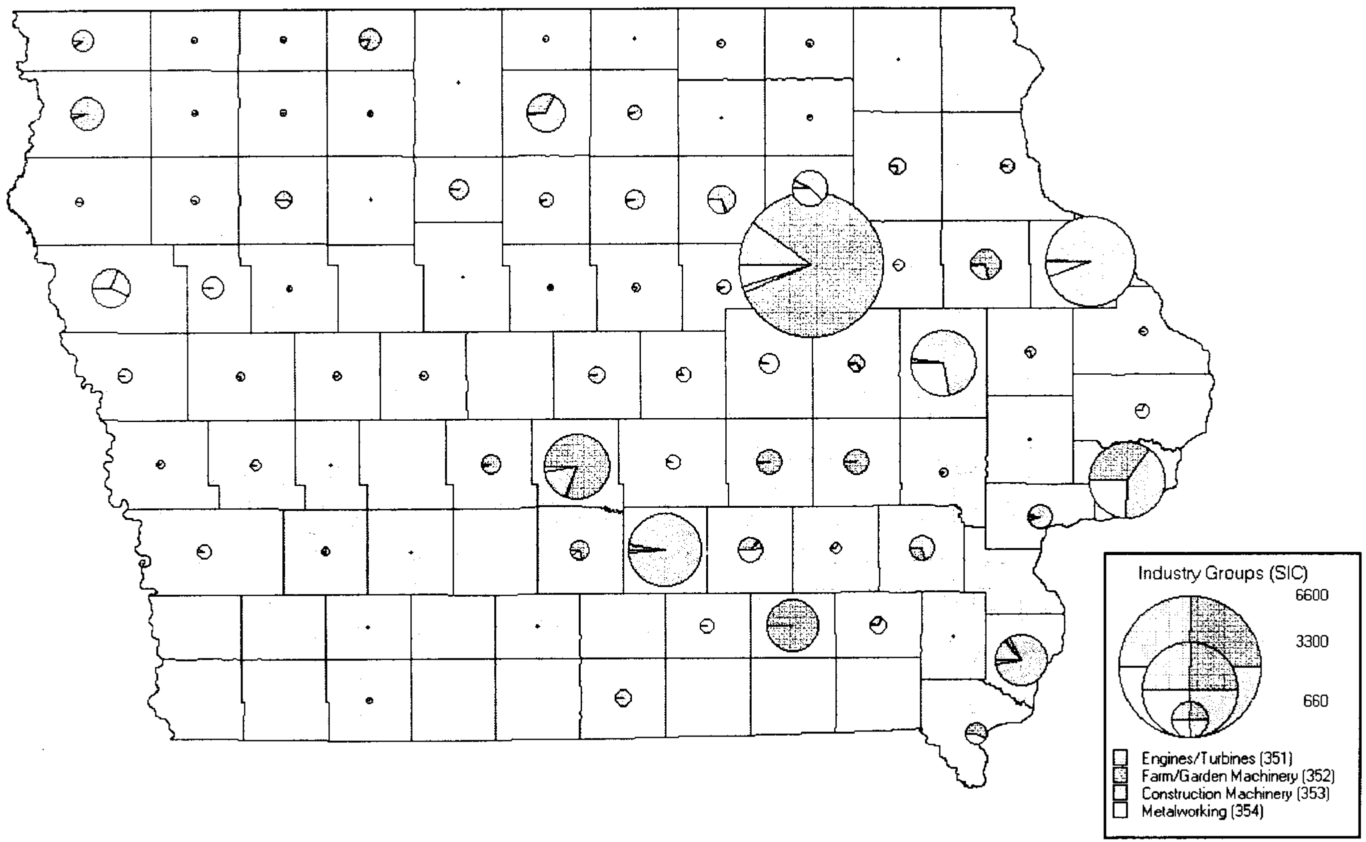
As previously mentioned, we have followed a layered approach in building a freight transportation model for Iowa. This is based on the assumption that the demand for truck transportation in one economic sector is independent of truck transportation demand from other economic sectors and, therefore, they can be modeled separately. For example, the demand for transportation to ship meat products is unrelated to the demand for truck transportation service to carry construction machinery. In addition, when trucks carrying traffic from different industry segments are assigned to the transportation network, they interact independently of other trucks and vehicles in the transportation system (i.e., congestion is not an issue). Further, the economic activity producing truck traffic is not uniformly distributed across an entire state or region and is concentrated within a few locations, allowing further segmentation by location.

To illustrate the concentration of economic activity, Figure 2 shows the level of employment data at the three-digit level of the Standard Industrial Codes (SIC) for the predominant economic subsectors within SIC group 35, machinery industries. Employment is shown because it indicates economic activity in this sector and can be correlated with freight transportation services demanded. Employment in Figure 2 is aggregated by county. In this category the largest number of individuals is employed in the farm and garden machinery subsector followed by construction machinery. Although many counties have some employment in this sector, the majority of the employment in the machinery sector is concentrated in a very few counties. Thus in terms of modeling measurable transportation activity for each commodity group, only a few significant locations require analysis.

In Iowa, we have already built pilot truck traffic demand models using this method of decomposing the demand modeling process into layers[4], and we are currently in the process of building models which will support statewide transportation planning and policy making by building layers of very simple models where each layer models traffic from one economic subcategory. For example, one of the most common commodities carried by trucks in Iowa is meat products. In a 1991 truck traffic survey, roughly 20 percent of the truck traffic originating in Iowa was carrying meat.[5] Only insignificant quantities of meat are shipped by rail, therefore, rail movements are, for all practical purposes, irrelevant, and thus modal choice can be eliminated from the modeling issues. In addition, meat products distribution throughout the U.S. is inversely proportional to the distance to a destination and proportional to the population at each destination, making meat product traffic a perfect application for distribution using a simple gravity model. Lastly, meat producing is concentrated in a few large processing plants. As a result, meat product freight transportation demand models which will load traffic onto a highway network common to all similar traffic are being constructed.

Number of Employees

Selected Industry Groups



Conclusions

The four-step urban travel demand modeling process was developed to fulfill objectives which are different from those which are typically addressed by statewide or regional freight transportation demand modeling. Clearly, urban travel demand models were intended to address questions of congestion and capacity. Such capacity issues are generally not a central issue for planning intercity freight transportation facilities and services. Because capacity is not an issue, all freight traffic does not need to be simultaneously assigned to the transportation network, thus allowing the segmentation of freight into commodities with similar transportation demand. Each segment can then be assigned to the transportation network, culminating in a complete model of freight transportation demand.

In Iowa, we have built pilot freight transportation demand models based on the principal of layers. These pilot models performed well in initial tests. However, field data must be collected before the models can be use for transportation planning purposes. We are currently in the process of conducting the supporting work for the development of statewide freight models for the State of Iowa, layer-by-layer.

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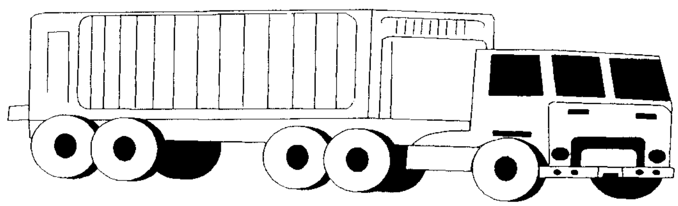
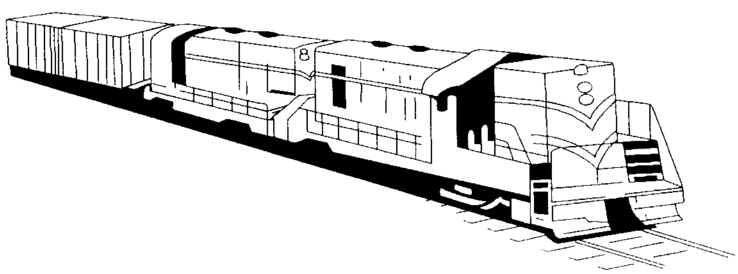
CONFERENCE TWO
DISCUSSION GROUP QUESTIONS





14. PART 1: EXISTING MODELS QUESTIONS FOR CONSIDERATION BY THE DISCUSSION GROUPS

1. Do you develop freight models, apply models developed by other, or use forecasts prepared with models?

2. With what models have you had experience?

3. How was each model or forecast used:
   - part of routine procedures
   - for special studies
   - for test cases

4. How long have you been using each model or the results of a model?

5. How does your model work or:
   - is it a black box
   - does it address -- origins and destinations, shortest path, delivery by type

6. What other factors are considered in the model?

7. What written descriptions of the model framework and contents are available?

8. Has the model been validated over time?

9. At what level does the model operate:
   - TAZ
   - Community
   - Corridor
   - Other

10. Can the model address policy issues? What policy questions have been addressed?

I 1 . What alternatives have been evaluated?

12. How does the model incorporate public and private participants in decisions?

PART 2: FUTURE MODELS QUESTIONS FOR CONSIDERATION BY THE DISCUSSION GROUP

1. What characteristics are most needed in new models (in order of priority):
   - consistency with theory, defensibility
   - ease of use
   - faster response
   - a battery of techniques ranging from quick response to more comprehensive, but more complex and time consuming models
   - ability to address a range of policy questions; which ones; what factors need to be modeled

2. What new or better employment, freight by type and amount of information should the model provide? In particular:
   - what information is needed by models
   - what information is need by models for air quality planning
   - how would the model be otherwise useful

3. At what level of accuracy and detail are the characteristics discussed above needed?

4. What issues and alternatives should a freight model be able to evaluate and/or assess?

5. What input data would new models need?

6. How could that data be obtained or produced?

7. What barriers are there to obtaining the needed inputs and how could those be overcome?

8. How and by whom should new models be developed?

9. Have you other comments about the models discussed above?

10. Does the model forecast:
    - commodity flows by class or type
    - vehicle trips

11. How does the model handle needs of travel demand forecasting models and the transportation planning process?
    - in urban areas
    - in rural areas
    - state level analysis
12. What data or analysis needs is the model designed to satisfy?

13. For your model how much confidence have you in its forecasts?

14. What problem have you experienced with each model? Have you had problems with:
    - obtaining and/or maintaining the model the level of staff needed to understand and use the model
    - obtaining data needed to estimate or calibrate the model
    - the amount of time it takes to prepare a forecast
    - the model's ability to match observed patterns
    - the model's level of detail or scale at which the model operates
    - olicy makers believing the forecasts
    - policy makers ability to understand the model

15. Have you tried more than one model? How did it compare with the model you are using now?

16. If you have not used a formal freight model or results:
    - What kinds of freight data do you maintain
    - For what purposes do you use the data

17. What changes are needed in existing model

18. How can those improvements be best accomplished:
    - further research
    - better data
    - testing and modification

19. Why do you need a freight model?

20. How can the problem of data availability, reliability and cost of data collection be addressed? How can the validity of data be maintained?

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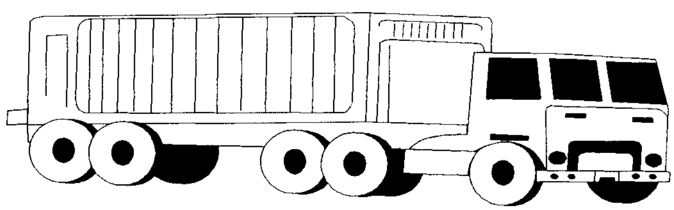
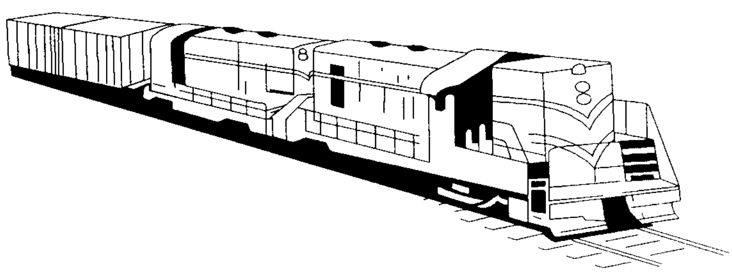
CONFERENCE TWO
CONFERENCE PARTICIPANTS





15. LIST OF CONFERENCE PARTICIPANTS

Mr. Felix Aneh-Tague
AMTECH Inc.
1101 15th ST., NW, Suite 900
Washington, DC 20005

Mr. Preston Beck
Port of Portland
700 NE Multnomah
Portland, Oregon 97332

Mr. Russ Capelle
CTP Planning Staff
State Transportation Building
Ten Park Plaza, Suite 2150
Boston, MA 02116-3968

Mr. Jorge Castillo
MPO
#2 Civic Center Plaza (8th Floor)
El Paso, TX 79901

Mr. Larry Castillo
Railroad Section
N.M. Hwy. & Transpn. Dept.
220 Pera Bldg., P.O. Box 1028
Santa Fe, NM 87503

Mr. George Cepress
Minnesota DOT
395 John Ireland Blvd., MS 450
St. Paul, MN 55155

Mr. Arun Chatterjee
University of Tennessee, Dept. of Civil Engineering
11O-C Perkins Hall
Knoxville, TN 37996-2010

Mr. Harry Cohen
Cambridge Systematics Inc.
150 Cambridge Park Drive
Cambridge, MA 02140

Mr. Teodor G Crainic
INRO Consultants
University of Montreal, C.F. 6128
Montreal, QC W3C3J7
Canada

Mr. Robert Czerniak
New Mexico State University
Department of Geography
P.O. Box 30001, Dept. MAP
Las Cruces, NM 88003

Mr. Rick Donnelly
Parsons-Brinkerhoff, Quade & Douglas, Inc.
5801 Osuna Rd. NE, Suite 220
Albuquerque, NM 87109

Ms. Lisa Douds
Washington DOT
400 7th St SW, Rm P2-0336
Washington, DC 20590

Ms. Kim Fisher
Federal Highway Administration
400 7th St. SW
HEP 22, Room 3232
Washington, DC 20590

Ms. Moncia Francois
400 7th St. SW, HEP 22
Washington, DC 20590

Ms. Sandra Gaiser
New Mexico State University
Department of Geography
P.O. Box 30001, Dept. MAP
Las Cruces, NM 88003

Mr. Keith Garber
H-GAC
Houston, TX 77027

Mr. James Godfrey
Sandia National Lab
P.O. Box 5800
Albuquerque, NM 87185

Mr. Alan Horowitz
U. of Wis.-Milwaukee
Civil Eng. & Mechanics
P.O. Box 784
Milwaukee, WI 53201

Mr. Hamid Humeida
MWCOG
91 0 Benson Terrace
Silver Spring, MD 20901

Mr. Eric Irelan
Skagit Council of Governments
204 Montgomery Ave.
Mount Vernon, WA 98273

Mr. Dane Ismart
FHWA
HEP 50
400 7th St. SW, RM 3301
Washington, DC 20590

Mr. Robert Koehler
OKI Regional Council
801 B. W. 8th St., Suite 400
Cincinnati, OH 45203

Mr. Konstantinos Koutsoukos
NCTCOG
P.O. Box 5888
Arlington, TX 76005-5888

Professor Hani Mahmassani
University of Texas at Austin
Department of Civil Engineering
ECJ Hall 6.2
Austin, TX 78712-1101

Mr. Keith Mattson
Associate Planner
Metropolitan Transp. Commission
101 8th Street
Oakland, CA 94607-4700

Mr. Thomas Maze
Director, Ctr. for Transpn. & Resch.
Iowa State University
2625 N. Loop Dr.
Ames, IA 50012

Ms. Deborah Matherly
COMSIS Corporation
8737 Colesville Rd., Suite 11
Silver Spring, MA 2091 0

Mr. Jason McKinley
Michigan DOT
425 W. Oftawa, State Transportation Bldg.
Lansing, MI 48823

Mr. Steve Natzke
FHWA
400 Seventh St., SW
Washington, DC 20590

Ms. Bahar Norris
U.S. Department of Transportation
Economic Analysis Division DTS-42
Kendall Square
Cambridge, MA 02142-1093

Mr. Ken Ogden
Monash University, Dept. of Civil Engineering
Wellington Road
Clayton, Victoria 3168
Australia

Mr. David Owens
NOACA

The Atrium Office Plaza, 668 Euclid Ave.
Cleveland, OH 44114

Mr. Christopher Primus
Denver Reg. Council of Governments
2480 W. 26th Ave., Suite 200 B
Denver, CO 80211

Mr. Mauarizio Riccio
DYNCORP
400 7th St. SW
Washington, DC 20590

Mr. Michael Sclar
DRI/McGraw Hill
24 Hartwell Avenue
Lexington, MA 02173

Mr. Robert Siegfried
H-GAC
Humble, TX 77346

Mr. LaRon L Smith
Los Alamos National Laboratory
P.O. Box 1663
TSA-DO, MS K575
Los Alamos, NM 87545

Ms. Leigh Stamets
California Energy Commission
1516 9th St., MS 22
Sacramento, CA 95814

Ms. Vicki Taggart
New Mexico State University
Department of Geography
P.O. Box 30001, Dept. MAP
Las Cruces, NM 88003

Ms. Samantha Taylor
ARRB Transport Research Ltd.
500 Burwood Highway
Vermont South, Victoria 3133
Australia

Mr. Matthew Thornton
Atlanta Regional Commission
200 N. Creek, Suite 300
Atlanta, GA 30306

Mr. Randall Wade
Wisconsin DOT
4822 Sheboygan Ave. Rm. 901
Madison, WI 53707

Ms. Nancy Whalen
ATR
1001 University Blvd. S.E., Suite 103
Albuquerque, NM 87106